THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

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Electric Railway Signals.

It is not always by exhausting the vast wealth of resources at its command that electricity renders the most valuable service to the arts. On the contrary, it is oftentimes while performing functions of the simplest nature that it plays a part of the highest importance. Nothing demonstrates more plainly and more beautifully the ease with which electricity can thus lend itself to the attainment of useful results than its application to signaling purposes on railroads. The easy adaptation of electrical circuits to signaling devices affords to the railroad a most valuable factor of safety and precision of operation, for when electricity becomes the watchman or the flagman, it scans every symptom of danger with untiring vigilance. When its efforts are guided by skillful methods and when its tasks are performed under well-adapted, properly-defined systematic conditions, it becomes an intelligent agent, the powers of analysis of which the human mind itself cannot rival. It scouts every sign of thoughtlessness or carelessness to which may be ascribed so many disastrous calamities. It speeds unfailingly the message of advice or of caution, as if it itself realized the importance of its mission. In short, it attends to its duties at all times with that readiness and alertness which characterize the willing and devoted servant.

The study of methods of signaling by electricity on railroads for the purpose of preventing collisions and accidents, was one of the first channels through which inventive effort was directed to the advancement of electrical science by industrial development. The subject early attracted the attention of electricians and inventors, and many inventions have resulted from their efforts and of those who followed them in the same path. Strange to say, however. while the fundamental principles involved are most simple, only a few of the ideas and systems formulated and invented possessed any practical value, and it has been only within a few years that a satisfactory solution of the problem of electric signaling on railways has been reached for the first time.

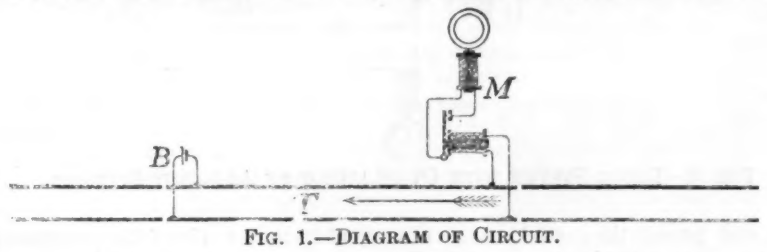

FIG. 1.—DIAGRAM OF CIRCUIT.

Although the history of this application of electricity might prove interesting to a few, yet it possesses so little of value in the way of principle or suggestion, that we can well afford to dispense with it. The careful analysis of the results obtained by the best practice of the present time will afford us all the information that we could hope to procure by a systematic inquiry into the systems which preceded those now in use.

The electric railway signal system of the Union Switch and Signal Company, of Pittsburgh, Pa., whose exhibit formed so interesting a feature of the Railway Exposition at Chicago, and of which we give an account below, seems to be at once the simplest and most complete of those now before the public. We select it because we believe that to describe it will convey much new and valuable information to a large class of readers, and be very acceptable to many specially interested in this field.

The function of a system of signals on railroads may be defined as four-fold: First, the prevention of collisions by trains meeting; second, the prevention of collisions by moving trains running into stationary trains; third, the prevention of accidents from damages and mishaps to the railroad track; and fourth, the prevention of accidents from misplaced switches. Moreover, it is not enough that the mere presence of danger should be indicated by the signal; it is desirable that it should be to some extent *located* as well. For instance, if two approaching trains are ten miles apart on the same track, there is no immediate or serious danger of collision; but when they have arrived within less than a mile of each other, the danger has become imminent. A signal of danger produced while the trains are still several miles apart would only cause inconvenient and useless delay. The signal should come to the engineer's notice at a shorter time than this, but one long enough to leave a good margin of safety. In other words, the system should, so to speak, possess the faculty of automatically discriminating between a remote and an immediate danger.

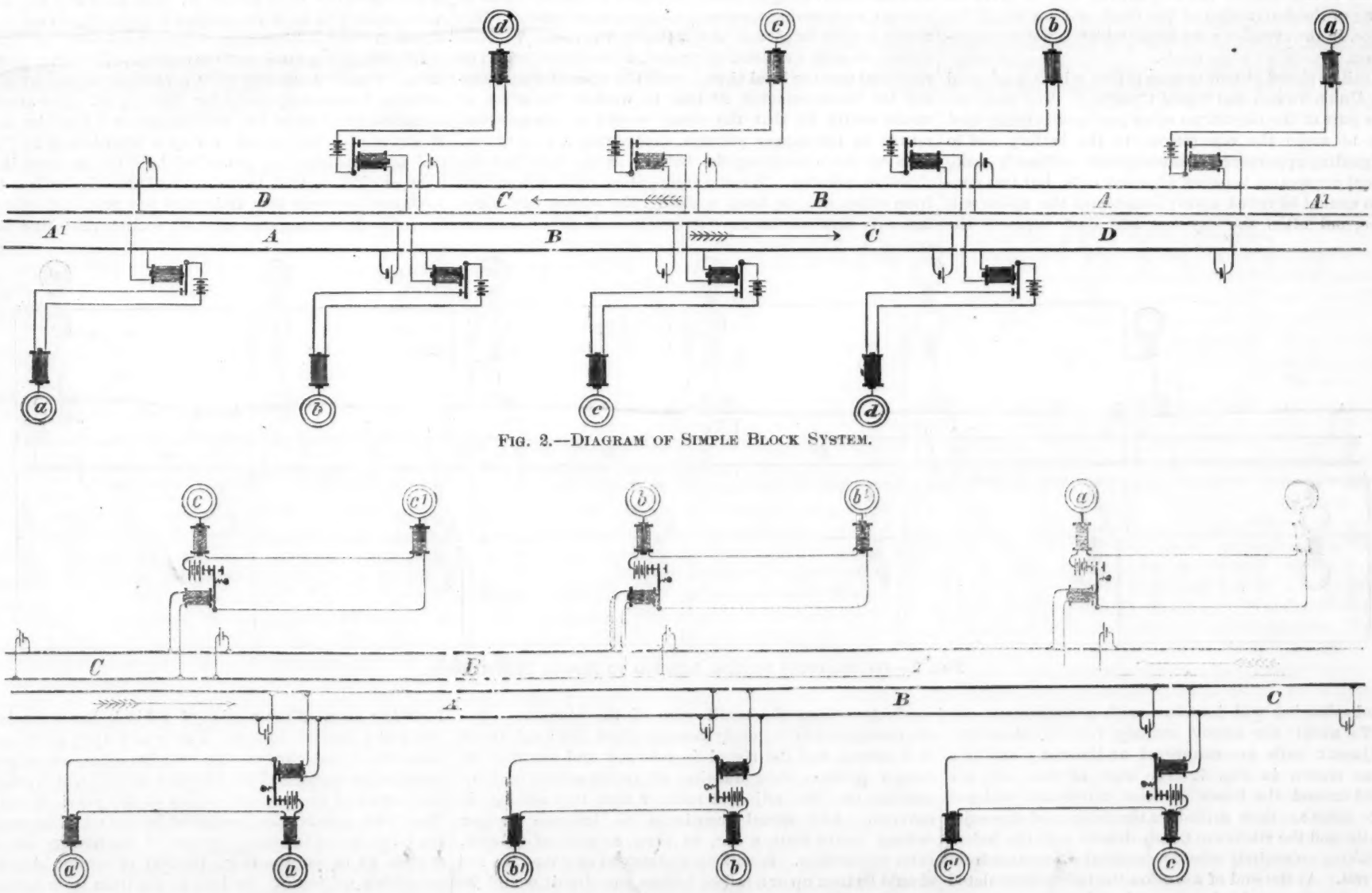

FIG. 2.—DIAGRAM OF SIMPLE BLOCK SYSTEM.

FIG. 3.—OVERLAPPING SYSTEM WITH TWO SIGNALS.

This valuable requirement is fulfilled easily by dividing the railroad line into sections or blocks of a mile or less, each of which is electrically distinct from the others adjacent, and connected with its own battery and signaling devices. A signal service of this description is called a "block system." The system of the Union Switch and

Signal Company is of the "block" variety, as are in fact all of the signal systems in use on American railroads.

There are two distinct generic kinds of block systems, the open circuit and the closed circuit systems, or the wire and the rail systems. In the first of these there is a wire circuit which is closed when a train enters the block. The electro-magnet included in this circuit then works the semaphores of that section so as to indicate danger. When the train reaches the end of the section the circuit is again opened and the danger signal removed. This variety of block system is not well adapted to the requirements of safety, because it fails in a most important point, that is to say, *it does not render the display of a safety signal when danger exists an impossibility.* For instance, a car may become detached and remain in the middle of a section, and yet the wheels of the locomotive arriving at the end of section would operate the circuit opener, and the safety signal would be displayed. The same thing would happen if a train had to back into a section just passed over- the signal at the semaphore would indicate *all clear*, because in the wire system there is no circuit closing device at that end of the section. Another urgent objection to this kind of block system is, that it gives no warning of the destruction of the track or roadbed, as for instance, in the event of a washout, which is not an unfrequent occurrence on some roads.

The rail or closed circuit system is that which is adopted by the Union Switch and Signal Company. The rails are made a part of the circuit, no other conductors being used except to make the connections to the battery and to the signaling apparatus. The fish-joints ordinarily make electrical connection between adjacent rails, but this connection cannot be relied upon; sometimes the splice will be loose, and often the dry-rust and dust between the rails and splice-bar will interfere with a continuous circuit. To make the circuit entirely reliable, therefore, the adjacent rails are connected at the rail joints by a wire, as shown in Fig. 7. The ends of this wire are wrapped around the heads of stout rivets and soldered thereto; holes are then drilled in the flanges of the adjacent rails, and the rivets are firmly driven into the holes, thus making an entirely reliable electrical connection from rail to rail. At the end of a section the rails are insulated from each other, and of course the wire connection is omitted.

Fig. 1 is a diagram of a "block," from which an idea of the principle of operation of the system will be readily obtained. *T* is a section of railroad track, of the desired length, usually about a mile, insulated at each end from the adjacent sections. It will be seen that the rails serve as conductors between the battery *B* placed at one end of the block and an electro-magnet at the other end, the armature of which, when attracted, closes a local circuit, thus causing the electro-magnet *M* to hold the signal at "safety." The signal is so constructed that when left to itself it is at the "danger" position. As long as the electro-magnet *M* is active however, it remains held at "safety." This is a valuable feature, for since the normal condition of the signal is danger, any failure or interruption in the working of the system would bring out the danger signal. The battery *B* consists of a single gravity cell. This incredibly weak current is found to be sufficient, because the rails, with their large area of section, form conductors of such low resistance, and such care is taken to diminish the resistance at the joints that the effect produced on the electro-magnet is nearly the same as if it were connected directly to the battery without any intervening conductors. The chief advantage of using such a weak battery is that the electromotive force is so low. With a high electromotive force the presence of moisture in the ties, as after a rain-storm, would increase their conductivity sufficiently to permit the partial passage of current from one side of the track to the other, and if all the ties, or even the ground, were wet, then the electro-magnet would be literally short-circuited. The electromotive force of one gravity cell is not sufficient, however, to cause the current to be diverted in this way to any appreciable extent, and the result is that the electro-magnet always receives its proper share of current, even during the heaviest rain or snow storms. This result is most important, for if the electro-magnet did not receive its proper amount of current, its armature would be retracted and the local circuit would be opened, thus causing the electro-magnet *M* also to weaken, the effect of which would be that the signal would be released and return to the danger position, thus giving a false alarm. It is by short-circuiting the battery at the rails that the signal is operated. When a train enters upon the section from either end, or from a siding, the wheels and axles instantly short-circuit the current, because they are better conductors than the small wire of the magnet. The electro-magnet is instantly demagnetized, the local circuit *M* is opened, and the signal is released and assumes the danger position, thus warning all trains which may be coming on the adjacent sections that this section is covered. The signal continues to indicate danger as long as the train, a car, or even a pair of wheels, is on this section. It will be understood also that if a rail should be torn up or a rail be broken the circuit would be opened and the danger signal would be displayed. Any other cause of interruption of the current would also cause the display of the danger signal.

Fig. 2 represents a double track divided into blocks or sections *A'*, *A*, *B*, *C*, *D*, the arrow indicating the direction in which the trains travel. The operation of this system will be readily understood from the previous details. As long as a train remains on each section, *A*, for instance, its signal *a* is turned to danger. The signals are placed 1,500 feet more or less within the preceding section (*A'*), so that if the danger signal were displayed at *a*, a train coming on section *A'* would have time to stop before entering section *A*. An interesting and valuable result is the overlapping of signals by means of which the next section, say *B*, is made to indicate danger at *b*, before the signal *a* has been restored to safety. This result is easily explained by the fact that the first pair of wheels of the train leaving *A* short-circuits *B* as soon as it touches this section, while the rest of the train is still on section *A*, and keeps it short-circuited until the last pair of wheels has left it.

An evident improvement on this combination of signals is shown in Fig. 3. In this case there are two signals to each section the "primary" *a b c* and the "secondary" *a' b' c'*. The secondary signal of each section (*b'*) is placed back within the section just passed (*A*) at a distance of 1,000 feet or over from the beginning of the section controlling it (*B*). As shown in the diagram, both the primary and the secondary signals are operated simultaneously by the same relay magnet.

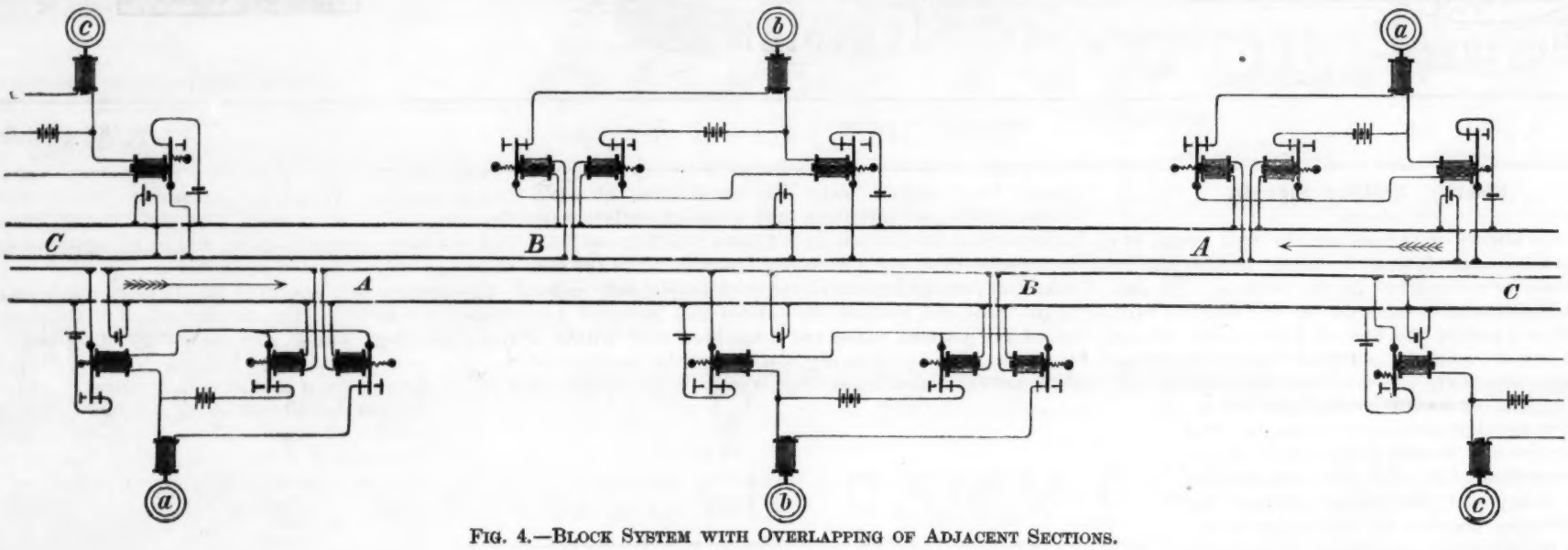

FIG. 4.—BLOCK SYSTEM WITH OVERLAPPING OF ADJACENT SECTIONS.

The operation is exactly the same as in Fig. 3, but the overlapping of signals is more perfect. A great advantage is that the secondary signal of a section, say *b*, may be set at a slight distance ahead in the section so that it will operate before the train passes it, thus enabling the engineer not only to see if the section is clear, but to see if the signal changes as his engine enters on this section (*B*).

The overlapping of signals is carried still further in some cases. Figure 4 shows a more perfect arrangement of the sections, intended specially for this object. The arrangement and relations of the circuits are such that the signal of any section just passed over by a train is held to "danger" until the train has proceeded 1,000 feet or more in the next section, so that there cannot possibly be less than 1,000 feet between this train and any train following it. Each block is composed of two sections, the first being 1,000 feet long. Each section of a block has separate circuit and a separate battery. The local battery at the semaphore divides its current into two branches, one of which includes the signal and the other the magnet which controls the circuit of the second portion of the previous section. These two circuits are controlled by the relay magnets of the large and of the small portion of the block. Suppose a train to be on the large portion of section *A* and approaching section *B*. As long as the train is on section *A* the battery of that circuit is short-circuited, the relay-magnet falls back and the semaphore *a* continues to indicate danger. Now the train enters *B*. The magnet of the short section is short-circuited, and consequently its armature is thrown back, the local circuit which it controls is opened and the magnet at the end of section *A* releases its armature and opens the circuit on that section (*A*). In this condition the last wheels of the train can leave section *A*, and still the signal *a* will remain at danger It continues to remain at danger until the train has passed over the short portion of section *B*. The moment this happens the magnet of this short section becomes active again

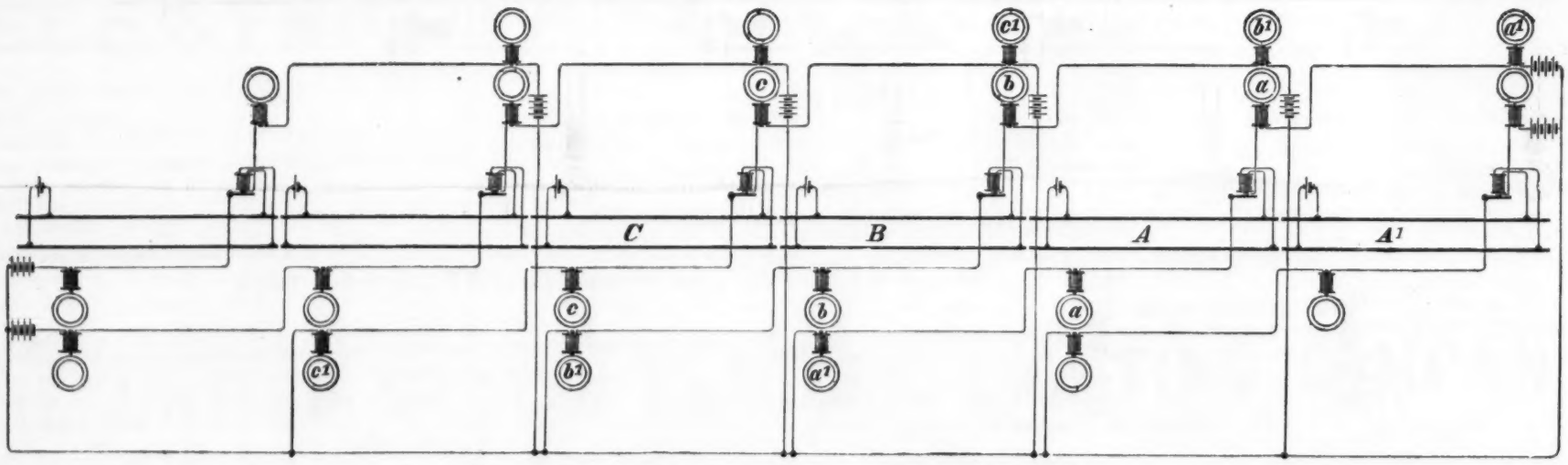

FIG. 5.—OVERLAPPING SYSTEM APPLIED TO SINGLE TRACK ROAD.

closes its local circuit, and works the magnet which closes the circuit on the second portion of section *a*, thus bringing back the signal *a* to safety again. The same process will repeat itself as the train passes the succeeding sections *C*, etc., on the road.

The overlapping block system is also applicable to single track roads. In this case the arrangement of circuits is such that the overlapping takes place in either direction, the signals for trains in one direction being on one side and those for trains going in a contrary direction being on the other side. The combination of the circuits for attaining the perfect and independent working of signals to trains going in contrary directions on one track is shown in Fig. 5. It is one of the most ingenious of arrangements, though it is comparatively simple, and will be readily understood. If a train be entering on section *A* from section *A'*, the moment the wheels touch the rails of section *A*, the signals *a* and *a*, at the ends of the section and on opposite sides of the track, turn to danger, and also the secondary *a'* and *a'*, which are respectively a whole section back and front of section *A*, and are also on opposite sides of the track. Thus the train is not only protected while fully within a section, but also while entering and leaving, as no other train can be nearer than the length of a section. Should a train be traveling in the opposite direction, for instance, from section *C* to section *B*, the signals will turn in the same order, *i. e.*, *b* and *b* at the ends and opposite sides of section *B*, and *b'* and *b'* of sections *C* and *A*.

The Union Switch and Signal Company has added several accessory features of great importance to its block system. Among these are the connections at switches, which are fixed so that when a train enters a section while the track is clear, it is rendered impossible to throw any switch in front of the train (Fig. 6). The bridle rods at the switch are insulated so as to prevent short circuiting, and connections are made to a commutator, as shown by the dotted lines. When the switch stands as in Fig. 6, the long strip of the commutator is connected with the upper short strip, the circuit of signal *a* is completed and the signal is at

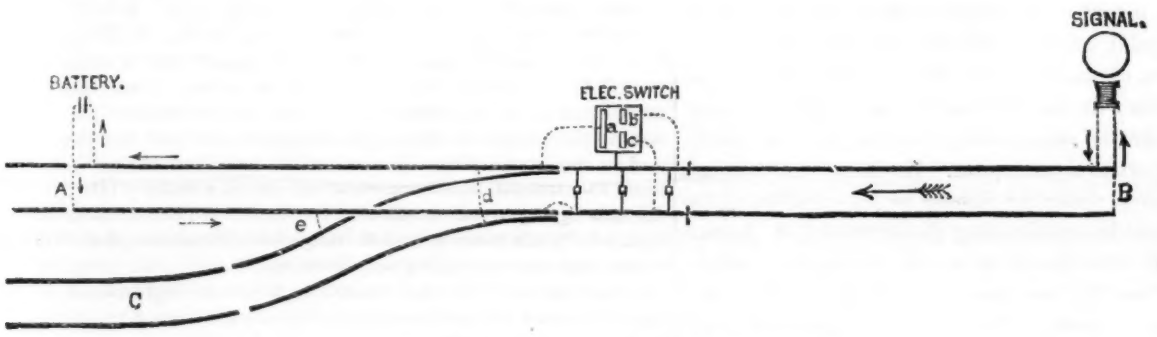

FIG. 6.—ELECTRIC LOCKING OF SWITCH.

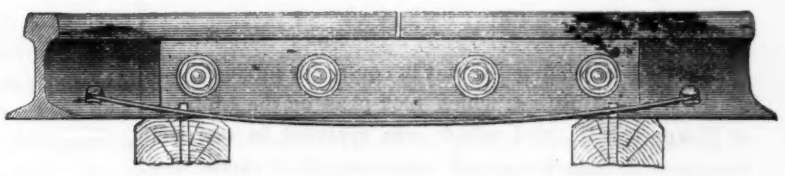

FIG. 7.—ELECTRICAL CONNECTIONS BETWEEN RAILS.

"safety." When the switch is moved to the side track the lower short strip of the commutator is connected with the long strip and the signal *a* is at danger. Several switches may thus be connected in like manner, and their condition will be reported by the signal; though when the latter is not conveniently located it is better to use special switch signals. As a precaution against the turning of the switch through ignorance or mischief, the lock is so constructed and connected with the circuits that it cannot be unlocked except by means of its proper key, which is in the hands of the trainman. In certain cases signals are so electrically locked with switches that the switch lever cannot be moved until after the signal is turned to "danger," and conversely the signal cannot be put to safety only by locking the switch in its place.

The locking of drawbridges is another of the highly important results which the combination just described is capable of effecting. The locking bolts are connected with the signals, which turn to safety when the bridge is locked and to danger when it is unlocked. When once the train enters on the bridge section while the signal is at safety, the lock of the draw cannot be tampered with, because it is locked by electrical means until the train has passed. Perhaps the most valuable application of this idea is its use with the interlocking switch system of the Union Switch and Signal Company at large railroad stations, freight-yards, etc., where all the switches are controlled and manipulated from a distance by means of levers all conveniently disposed in a "switch tower," from which the operator can command a view of the whole ground. In some cases the levers are directly connected by rods and arms to the switches; in other cases the levers serve only to direct the action of hydraulic or pneumatic pressure which is used to move the switches and their signals. The levers are connected to the switches and signals and with themselves in combinations, or "interlocked" in such a manner that it is impossible to set conflicting signals for approaching trains. However, it might be possible for an operator to change a distant signal as soon as the engine has passed it, and then to reverse the "home" signal and move the switch in front of the train—an error which has actually caused serious accidents. The automatic electric locking of the levers by the presence of a train upon the rails, is, accordingly, one of the most important features of interlocking switches and signals, for the reason that after a "clear" signal has been given and a train has passed it, it is impossible for the operator to move any lever until the train has passed beyond the danger point, thus rendering mistakes by the operator absolutely impossible. To accomplish this, an electric circuit is established through the rails or track instruments used, and the wires carried to an electro-magnet which is preferably attached to the spring catch-rod or spindle of the switch lever to be locked, but the locking may be done at any convenient point of the connections from the lever to switch signal or switch locking bolt. By means of a spring the armature of the magnet is made to lock the catch-rod in position when the current is interrupted, but when the circuit is completed the magnet draws the armature away and leaves the catch-rod and its lever free to be moved. The mode of operation is this: As long as there is no train on the insulated portion of the track the circuit is unbroken and the magnet draws the armature away from the catch-rod, leaving the signalman at liberty to set the switch and signals for a coming train. As soon as the train has passed the insulated point, the current is short-circuited and the armature released, and by action of the spring is drawn into a slot of the catch-rod, thereby locking it and its lever in place, and it is impossible to move the lever until the train has passed entirely off the insulated section; the circuit thereby being restored, the armature is drawn away from the catch-rod and the lever may again be moved.

We have not space enough to dwell at length on other applications of electricity in railway signaling, as alarms at crossings, station approaches and signal repeaters, which, though of minor importance, would greatly interest the reader. We have said enough, however, to give a conception of the valuable services which it is rendering that gigantic institution, the railroad. Electric signals are, indeed, among the most useful of railway appliances.

The New England Telephone Consolidation.

The stockholders of the Boston & Northern Telephone Company, at a special meeting at Lowell, Aug. 10, declared in favor of the proposed consolidation of the New England telephone companies. The stockholders of the Bay State, Southern Massachusetts and of the Suburban Telephone companies also took similar action; followed, on the 14th inst., by those of the Southern New England Company. By the 16th the stockholders of all the companies mentioned below as included in the scheme, had declared in favor of consolidation, excepting those of the Providence Telephone Company, which was to be put in at $800,000. This company, it is said, will not come into the arrangement, and it is probable that the stock in the new consolidated company to the amount named, which was to have been allotted to the Providence company, will now be retained in the treasury. It is not stated on what grounds the Providence people refuse their assent, but those who should be well informed say that it is only a question of time when the Rhode Islanders will come in.

The Lowell Telephone Syndicate has issued the following summary of the consolidation agreement, which differs materially from that previously published:

The American Bell Company to have $8,000,000 of the stock and 50 per cent. of any increase that may be made hereafter. They to waive dividends for three years for a sum not exceeding $60,000 the first year, $120,000 the second, and $180,000 the third, providing said sums are earned over the 6 per cent. dividend which is to to paid to the stock representing the property. One million dollars of the Bell stock will draw regular dividends the fourth year and $1,000,000 each succeeding year until all the stock comes in in eleven years. They will also have surplus earnings above 6 per cent. after the third year not exceeding $180,000 until the ninth year. On the ninth year they will have surplus earnings not exceeding $120,000 and the tenth year surplus earnings not exceeding $60,000. For this the American Bell Company gives the new company perpetual license for all patents they now hold or may hereafter acquire. The earnings of the New Consolidated Company will exceed 7 per cent. on dividend-drawing capital to-day, and a quarterly dividend of 1¼ per cent. will be paid, commencing October, 1883, for the three months dating from July 1.

The companies included, with the amounts of capital and subscribers, are as follows: The National Bell, of Maine, with $1,350,000 capital and 4,000 subscribers; the Boston & Northern, with $1,050,000 capital and 3,200 subscribers; the Bay State, with $728,000 capital and 2,700 subscribers; the Suburban, with $490,000 capital and 1,400 subscribers; the Granite State, with $132,500 capital and 450 subscribers; miscellaneous, $70,000; the Southern Massachusetts, with $711,000 capital and 1,700 subscribers; the Providence, with $800,000 capital and 2,500 subscribers; the Southern New England, Connecticut & Inter-State, with $1,679,500 capital and 5,000 subscribers; the American Bell Company, with $8,000,000 capital, and the Boston, with 2,200 subscribers. There is in the treasury $800,000 unissued stock and $200,000 cash, making a grand total of $16,000,000, with 23,150 subscribers. Of the subscribers, Lowell companies contribute 11,750, the Southern New England companies 9,200, and the American Bell Company, of Boston, 2,200. This consolidation may be regarded as significant of early movements in the same direction.

Trial of a New Electrical Launch.

The latest issue of the London *Field* received in this country contains the subjoined account of the successful trial of a steam launch constructed to be shown at the Vienna Electric Exhibition.

A launch propelled by electricity was shown on the Thames on several occasions last year and attracted a good deal of attention. It was propelled by a screw driven by a Siemens motor and Sellon-Volckmar accumulators. To a certain extent the experiment was successful. Recently Messrs. Yarrow & Co. of the Isle of Dogs took the matter up, and working with the Electrical Power and Storage Company, a very handsome launch has been fitted up, intended for the Vienna Exhibition, with which many experiments have been made. On Tuesday this little boat made a run from Temple Pier to Greenwich in thirty-seven minutes, with a moderate tide. Some delay was moreover caused by the propeller fouling a basket—an event well known to every one who has had any experience with steam launches on the Thames. The distance is six miles, so that, making allowance for the tide, it may be said that a speed of over seven miles an hour was attained, and full power was not employed save for a portion of the time. On the measured mile an average speed of over eight miles an hour has been obtained.

The boat is forty feet long and of good beam. She had twenty-one persons on board, including the steersman and a man to look after the machinery, if such it may be called. The boat is completely unencumbered from end to end, no trace of the propelling mechanism being visible. This consists of eighty cells of Sellon-Volckmar accumulators of which fourteen are disposed under the seat, seven at each side, and the remainder in the bottom of the boat, under the floor. The screw is turned by an A. Siemens dynamo commutated as a motor. No gearing is used, the spindle of the armature being coupled direct on the end of the screw shaft. The thrust block is just aft of the dynamo, which is placed under the floor in the stern sheet. It lies flat, and occupies very little space. There are four brushes, two for going ahead, two for going astern, and two small lines going to a becket beside the steersman enable him at a moment's notice, by pulling one or the other to go ahead or astern; a cylindrical switch beside him enables him to stop or go on at pleasure. This switch is graduated so that the current from forty, sixty or eighty cells can be used at pleasure. The weight of the whole—batteries and dynamo—is about two tons, or as nearly as possible that of engine, boiler with water, and coal for a steam engine competent to propel her at the same speed.

This pretty launch is the very perfection of a pleasure boat; no heat, no smoke, no dust, no steam, no smell of oil, no splashing of pumps. There is no noise of any kind to be heard save the bubbling of the water from the propeller and the faint hiss caused by the commutator rubbing against the brushes. There is no smell, and no "blacks;" and the boat will run for six hours continuously, or about forty-five miles.

It has long been known that the screw is an extremely wasteful propeller. It may yet be that further investigations will show that the screw is not so much to blame as the combination of screw and engines. At any rate the system of electrical propulsion opens up a new field of inquiry, because it renders possible the use of screws of extremely fine pitch revolving at a great speed. The dynamo in Mr. Yarrow's boat makes about 680 revolutions per minute. The propeller is of steel, two bladed, nineteen inch diameter and thirteen inch pitch. There is absolutely no vibration, and little disturbance of the water in the wake of the boat

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THE GRAMME PATENT SUIT.

The final hearing of the suit in equity for infringement of the Gramme patent, which took place on the 9th inst., at Newport, R. I., and which was reported in our last issue, has created a ripple of sensation and of excitement in the electrical community which is scarcely less interesting than that by which the recent decision in the telephone interference case was attended.

This sudden manifestation of vitality in a case that has been pending in the courts for over two years and which was supposed by many to have died of inanition, is a kind of surprise to electrical men generally. It looms up above the horizon of the electric light world as a meteor of doubtful omen to all electrical inventors not under the protecting wing of the Gramme Electrical Company, to the capitalists who have been aiding their efforts, and, in short, to all the electric light enterprises not affiliated to the original seven companies constituting the Gramme combination. The final arguments have been made, and in due time the decision of the learned judge will be forthcoming. While the decision is pending, however, the anxiety in certain quarters will necessarily be intense, and many of the small concerns now struggling into existence will seriously consider the question whether it is "to be or not to be" with them. If the decision is in favor of the Gramme Company, the situation will become interesting in the extreme. It is claimed by the Gramme Company that every practical dynamo-electric machine in operation in this country infringes more or less the Gramme patent. Hence, in the event of a decision in its favor, we may expect a series of injunctions to be sown broadcast upon the "un-orthodox" electric light companies. It is true that the Gramme patent will expire by limitation in about two years, but even in that short time much can be done to the detriment of the lesser interests. The Gramme Combination constitutes what might be called a collective monopoly, and we feel assured that it will not lose any time in profiting by the example of the other electrical monopolies, the Western Union and the Bell companies. Its remote object is always the monopoly of the whole field in favor of its constituents, and it cannot be expected that it will lose any opportunities to throw obstacles in the way of all competitors.

The case is of special interest to electricians and students from the fact that it bears on a warm controversy which has been waging within the last few years, about the priority of invention of the very subject of contention itself, namely the dynamo-electric machine which forms the type of all our present forms. In the year 1864 an Italian scientific periodical, *Il Cimento*, published a detailed and illustrated account of an "electro-magnetic machine," invented by one Doctor Antonio Pacinotti, professor of physics at the University of Pisa, which machine is constructed on the same general principle, and contains the same essential elements as the Gramme machine.

It is claimed by many that this machine practically anticipates the Gramme machine, and this is in fact one of the arguments of the defendants. The Gramme company, however, adduces a whole mass of evidence on the question in its endeavor to prove that the machine of Pacinotti as invented and as originally described, could not perform the function of a dynamo-electric machine satisfactorily. Models of this machine constructed exactly in accordance with the original description published in *Il Cimento*, and also of the original machine made by Gramme, were produced and operated in court by the Gramme company. The brief of the Gramme company advanced as many as eight reasons why the original Pacinotti machine could not work as a practical dynamo. It will no doubt be highly interesting to review the evidence on both sides, when the decision is promulgated and the evidence presented is made accessible and we shall endeavor to return to this controversy at a convenient opportunity, if only as a matter of general interest. The Arnoux and Hochhausen Electric Company, the defendant, did not rely altogether on the Pacinotti machine in their endeavors to prove the nullity of the Gramme patent. They contend further that this patent was void *ab initio* in consequence of not stating on its face the existence of the Austrian patent on the same machine. This introduces a technical point of law. The Revised Statutes of the United States, Clause 4887, state that a United States patent granted for a device after patents have been obtained in foreign countries shall expire when the foreign patent having the shortest term expires. The American Gramme patent, however, makes no allusion to the existence of the Austrian patent in enumerating those granted in foreign countries. It is further claimed that the Austrian patent has expired, and that the American patent is, *ipso facto*, void. But the question involves certain points of legal formalities and of the precedents of Austrian legal decisions, on which the judge will have to decide.

In a case where so many experts disagree, it will doubtless prove difficult even for a judge to decide, and the decision will not probably be reached before a month.

A Second Bunker Hill.

The strike has been the leading subject of domestic news during almost a month. Remarkable persistency has been shown on both sides, and the auxiliaries of both parties have maintained their share in the great conflict with equal perseverance. The Brotherhood have excellent reason to regard with grateful appreciation the readiness with which their cause was taken up by the strongest newspapers in the country, and the unfailing ability and steadfastness of these journals in advocating their cause. We feel fraternal pride in making these observations. Sneers at the alleged mercenariness of the press are frequent, but they are rebuked by the attitude which the best newspapers in all parts of the country have assumed with reference to the fight for the means of decent support which the operators have made against over-grown and greedy monopoly. The press has nobly championed the weak and not the strong; it has disdained the possible chance of "making a good thing" by taking the opposite side, and again throughout an honorable history vindicates the claim made for men of letters generally, that, as a rule, their sympathies are broad and generous. As a matter of course some prints, either owned or subsidized by monopolists, have done their utmost to damage the cause of the operators, while others, which one would think should fairly and fearlessly discuss the matter, have remained quietly "on the fence" ever since the strike began. The action of these papers has had most amusingly small results. This appears in the approximate unanimity of the public in approving the course taken by "the boys." The common sense of the people cannot but side with right against might; with need against extravagance and luxury; with a policy which, as expressed in the strike of the 19th ult., was assumed intelligently and thoughtfully and after a proper consideration of employers' rights, and has been maintained in an orderly, good-natured and courageous manner. Whatever may be the issue of the fight now in progress, even if wealth should score one more victory over poverty and necessity, the defeated party will have fought another Bunker Hill, a glory and an inspiration to a cause which, in the long run, cannot fail to triumph. This American atmosphere of ours is unfavorable to the assumption of life's good things by the few to the exclusion of the many; the public voice everywhere is raised against the lying pretense that the Western Union Company cannot afford to pay its operators sufficiently well to give them an existence at least tolerable to these able and intelligent citizens and their families. As a matter of fact the issue is past the stage of argument; the cause of the operators shines forth in demonstration obvious to every capacity.

Opening of the Vienna Electrical Exhibition.

On Thursday, August 16, the electrical exhibition at Vienna was opened by the Crown Prince Rudolph. Many thousands of persons were present, notwithstanding unfavorable weather. As a result of excellent management by the exhibition committee, many nations are interested in its success. The rapid increase of electrical appliances has, so far, given increased importance to every succeeding exhibition of them, and that of Vienna is said to be very superior in its scope and value to any preceding it.

According to a correspondent of the London *Daily News*, it is reached by means of an electric railway, which takes visitors from the Praterstern, at the end of the town, to the north gate of the rotunda in less than five minutes. The motive power is provided in the large machine department which encompasses the courtyards where the steam boilers, representing in all 1,200 horse-power, have been placed. The rotunda is devoted exclusively to the practical application of electricity, and is, therefore, to the public at large the most interesting part of the entire exhibition. The machinery department, besides showing how electricity is produced and applied, gives the expert a chance of judging for himself. The large gate of the rotunda will be lighted with incandescent lamps, and a dozen large arc lights on elevated masts will surround it. The engineers who have arranged the exhibition found it very difficult to light the rotunda in a manner to give the public an adequate idea of the value of electricity as an illuminating power. The diameter of the rotunda (built in 1872 by Scott Russell) measures 130 mètres, its greatest height 66 mètres. It was, therefore, impossible to illuminate the entire building with incandescent lamps. Along the gallery which runs round the so-called lantern, about 24 mètres from the ground, is placed a garland formed of 112 arc lights. At double the height are placed 28 very powerful arc lamps; and in the centre of the lantern, at the height of 60 mètres from the ground, shines a light of 20,000-candle power. All this light proved insufficient to illuminate the colossal hall. Fifty-six more large arc lamps were therefore placed within the arches, resting on pillars, and forming the large circular gallery. In the centre 36 more arc lights were placed, so that the total amount of light within the rotunda is 250,000-candle power.

The machinery department and the courtyards are lighted as brilliantly as the rotunda. The theatre forms a conspicuous feature in the Electric Exhibition. It is 340 feet long, and 48 feet wide, and is entirely illuminated by incandescent lamps, provided by the firm of Ganz & Co., Budapest. Of the 1,200 Swan lamps, 15 are placed in the entrance hall, 90 in the several ante-rooms, 184 in the body of the theatre, 30 in the orchestra, and 90 in the dressing-rooms at the back of the stage. There are 1,260 small lamps besides for lighting the stage, and these can be changed to any color at the turning of a handle. The engine and dynamo-room are in the machine hall, 350 yards distant, the conductors being laid underground. Experiments are also being made to light the theatre with arc lamps, which would be much less expensive. The public can judge for itself of the merits and defects of both systems. While the centre of the rotunda is filled with all appliances of telegraphs, etc., that part of the gallery which is not reserved for the theatre contains a number of "interiors," showing the application of the electric light to private houses. Every kind of apartment is shown, from the rich man's luxuriantly furnished *salon* to the poor man's simple kitchen, and everywhere the electric light serves its purpose. From the private apartments we pass on to an art gallery, where the effect of the electric light on pictures can be judged. Beyond that is a reading-room, where the public can consult the entire literature of electricity, and last of all are the rooms for telephonic music. The committee found great difficulty in deciding which locality was best suited to this part of the exhibition, the accumulation of electric conductors being so great in the rotunda that the telephone was likely to suffer from their influence. For the same reason these rooms could be but sparingly lighted. An arrangement has been made with the directors of the opera house, according to which the visitors of the Electric Exhibition will be able to hear the music and singing going on in the opera without moving one step out of the rotunda.

The total number of exhibitors is 600, representing 13 nations in all. There are 52 great boilers, the number of motors is 65, and there are 150 dynamo-electric machines. The total steam power represents 1,450 horse-power, from a machine of half-horse power to a giant motor of 240 horse-power. The exhibition comprises 15 different kinds of accumulators, including the very latest inventions in this branch of electricity.

The Postal Telegraph Company.

This company was strengthened on the 15th inst. by the accession of Mr. John W. Mackey, the millionnaire of California, to its directorate. Mr. Mackey took the place of Joel B. Erhardt as director, but declined to succeed that gentleman in the presidency. Twenty-one thousand shares of capital stock have been issued, of which a syndicate headed by Mr. Mackey, owns twelve thousand, giving it the control. The announcement is made that the stock will be placed in trust with Mr. Mackey for three years, during which time no member of the syndicate will be able to dispose of his portion, and the amount will remain intact. It is claimed for the Postal Telegraph Company that its system will prove to be cheaper and better than any existing one. Its business will be pushed energetically, a million dollars having been added to the capital within a few days past, and money being promised by the syndicate to any amount which may be necessary in order to the rapid development of connections. Low rates are being charged for the transmission of messages, namely, twenty words for twenty-five cents, irrespective of distance; and, since the 6th inst., when the lines were first opened, sufficient business has been done to warrant the expectation that the total expenses during this month will be covered by the receipts for the same period. At present the company uses its own lines between New York and Chicago, does business to Boston and Washington by an arrangement with the American Rapid Company, and to southern points by the lines of the Southern Telegraph Company. The company has formed plans for erecting wires between Chicago and St. Louis within 90 days; a line will be built forthwith from Olean, in this State, through the oil regions to Pittsburgh, Pa.; and others to connect with Detroit and St. Paul. Before long connections will be made with the East, and there are not wanting shrewd business men who see in the Postal Telegraph Company the money and the enterprise which may succeed in the creation of a competitor with the Western Union on a large scale. Whether this expectation be realized or not, the new company is affording the public a means of communication with many points at very low rates, and the rapid expansion of its business seems to be only a question of time.

The "Electro-Dynamic" Small Motor.

In publishing, at periodic intervals, original articles on electric motors, we felt that we were furnishing information interesting to a large class of readers. Our surmise was well founded, for we are in frequent receipt of communications from various quarters, which show plainly that the subject is at present receiving considerable attention. The idea of producing motive power on a small scale is popular in the extreme, possessing, as it does, an inherent fascination. There is a widespread desire to experiment with small electric motors, and it is for this reason that all details procurable about them are read eagerly.

The Griscom motor, now known as the "electro-dynamic" or "double induction motor," appears to be the only small motor in the market in this country. The consequence is, that there is more curiosity and more inquiry about it than about those which originated in Europe. We gave an extended descriptive notice of the electro-dynamic motor in THE ELECTRICAL WORLD of April 28, and are enabled to present this week illustrations of this motor and the battery made especially for supplying current to it, as well as other interesting devices used in connection with the motor. These illustrations will enable us to give a more definite idea of the appearance, construction and operation of the motor than it is possible to convey without them.

The electro-dynamic motor is remarkable for the small space it occupies. This is due to its neat and compact design, shown in Fig. 1, which is nearly full size. The armature is entirely incased by the cylindrical electro-magnet within which it revolves and by the metallic caps or discs fitted to this cylinder at each end. The cylindrical field-magnet is composed of a cylinder of soft iron wired in two large coils, each of which covers nearly one-half of the cylinder, the space left between the two coils at opposite sides of the cylinder constituting the magnetic poles of this cylindrical electro-magnet. The current which passes through the wire on this magnet circulates in opposite directions in each coil or section, so that both coils combine to produce a north pole in one of the open spaces and a south pole at the other. The result is practically the same as if two U electro-magnets were brought together with like poles in opposition, these forming a circular magnet with two consequent or combined poles, one at each junction. The iron of the cylindrical magnet projects laterally at each pole, and to these projections an ornamental brass disc is screwed firmly at one end, as shown in the figure. This disc forms one of the bearings of the armature shaft, which passes through it, and at the same time serves to protect the armature from injury. At the other end of the motor another brass plate is similarly fastened to the lateral projections of the poles of the cylindrical magnet. The shaft of the armature has a bearing in this plate also. The binding posts which receive the current from the battery pass through this plate. In the figure one is shown at the top and the other a little to the side of it. The binding post shown at the top is prolonged on the other side of the metallic cap, and carries one of the brass springs or brushes which serve to convey the current to the armature by pressing on the commutator. The other brush, touching on the opposite side of the commutator, is held in place by a special screw device attached to the metallic cap. The armature is of the well-known Siemens H pattern, such as is at present used in telephone call magnetos. The armature and the field-magnet are connected in series, as may be readily seen from the figure. The current, entering the armature

FIG. 1.

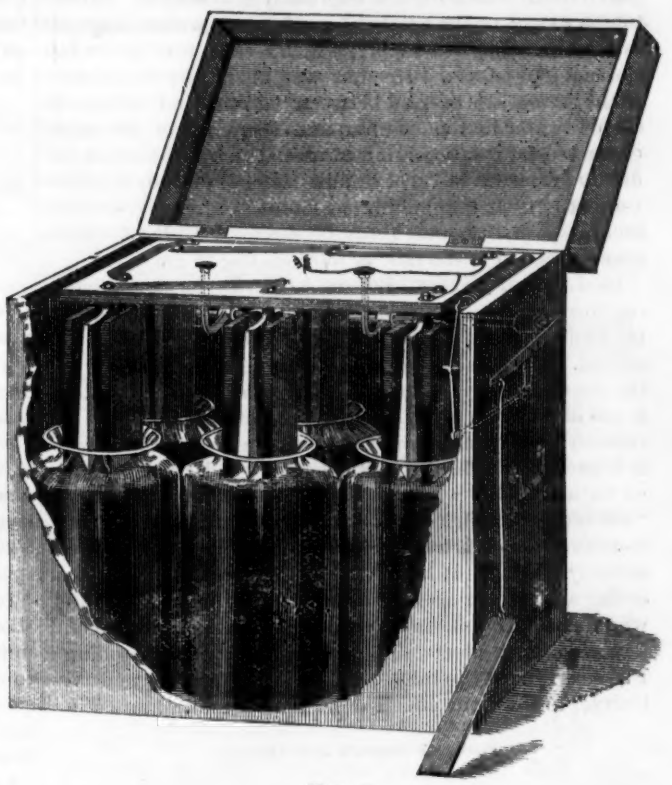


FIG. 2.

by the upper commutator spring, leaves it by the lower, from which it passes to the field-magnet, whence it goes to the second binding post.

The patent automatic battery, manufactured by the Electro-Dynamic Company of Philadelphia, makers of the motor, and specially adapted to the same, is illustrated in Fig. 2. This battery is of the bichromate of potash variety, and is contained in a neat ebonized case. It is composed of six carbon-zinc elements, each contained in a one-gallon glass cell. The zinc plate of each element is placed between two carbon plates, as in the Grenet battery. The plates are all fastened to a plate at the top. At the right-hand side is shown a treadle connected by a vertical arm to a lever, which is attached to a shaft extending through from one side of the case to the other. This shaft carries two bell crank levers, which extend from it and are attached to the plate supporting the battery elements. A strong spring normally supports the plates in their raised position, it being attached to another bell crank lever projecting from the shaft and the right-hand side of the case, as plainly shown by the dotted lines in the figure. It is evident that on pressing the treadle the battery plates will be lowered into the cells containing the solution, the degree of immersion being thus controlled by the foot. The device of the battery permits the perfect regulation of the supply of current to the motor. It is true that the electromotive force of the battery remains the same at any depth of immersion; but, on the other hand, the resistance of the battery diminishes proportionally with the increase of surface of contact between the battery plates and the solution. If the motor is required to run slowly, the treadle is depressed only just enough to immerse the plates slightly. If the work done by the motor increases or decreases momentarily, as often happens when it is used to operate sewing machines, the speed may be maintained at the same fixed rate by working the treadle to suit the work. By means of this device the speed of the motor may be varied with nicety from any number up to 15,000 revolutions per minute. For instance, the speed of a sewing-machine worked by this motor may be regulated so that it will make only 15 or 20 stitches a minute, which is extremely slow; or it may be increased to about 900 stitches a minute, which is a wonderful speed. The special advantage of this device is that when the foot pressure is removed, the plates are lifted out of the solution and all chemical action on the zinc ceases, while the battery remains constantly ready to be brought into action at a moment's notice. Since for the majority of purposes the power desired from the battery is obtained without entirely immersing the plates, the lower part of the zinc is consumed more rapidly than the upper portion, and for this reason it is made much thicker. The Electro-Dynamic Company prepares a special bichromate of potash or "electropoion" solution for this battery after its own formula; but any of the improved formulas of Trouvé and others recently published in this journal may be adopted in preparing the solution. With ordinary use the solution lasts a long time, and the expense of renewal is slight.

The electro-dynamic motor weighs only 40 ounces, and it is said that it can develop a power of 5.000 foot-pounds per minute (that is, nearly one-sixth of a horse-power) without difficulty. It appears to be in great demand for working sewing machines, and is also being used very extensively for many other industrial purposes, its use in some of which were especially discussed in our previous article. It has lately proved of great utility and convenience to surgeons, and especially to dentists, in driving various surgical instruments. The well-known dental engines used for rotating the excavating drills used to remove the decayed portions of teeth are all operated by a treadle, which not only obliges the operator to remain in fatiguing positions for several hours, but requires him to keep up a monotonous and tiresome movement. By a clever adaptation of the electro-dynamic motor to the flexible shaft of an S. S. White dental engine, these disadvantages are obviated. Fig. 3 shows the complete apparatus, which is suspended either by balanced cords from the ceiling, or from an adjustable arm, which allows it to remain balanced at any height or desired angle, thus relieving the operator of the weight of the apparatus and permitting him to manipulate the drills as delicately as a pen. The battery may be controlled by the foot, or if desired it may be allowed to remain immersed at the required depth by placing a weight on the treadle. The same battery may be utilized in many ways by the dentist. In many instances it is used to operate the electro-magnetic dental mallet, or for electro-cautery of diseased parts, etc.

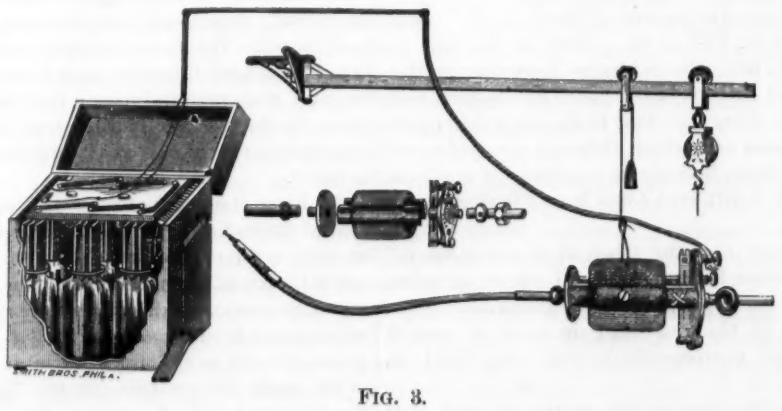


FIG. 3.

New uses are constantly being found for this remarkable little motor described. Its range of applicability is very great, and the readiness with which it can be adapted to a given purpose will continually enlarge its sphere of usefulness, by suggesting new industrial applications.

The Analysis of Ohm's Law.—II.

We give below the second part of the interesting dissertation of Mr. J. T. Sprague on Ohm's law, contributed to the London *Electrician*, the first part of which was reproduced in The Electrical World of Aug. 4.

15. The most convenient illustration of the mechanical effects of force, especially as connected with the study of electricity, is to be found in "hydraulics," that is to say, in the currents of water produced in pipes by the force of gravitation, which force is expressed as "head of water;" that is to say, as the height of a column of water, supposed to have an unlimited supply, which is capable of producing the required effects. Head of water is in fact the product of the attractions exerted between "earth" and each particle of water in the column, and therefore of the mass contained in, say, a column of unit area. As the unit fall due to gravity is 16.1 feet in unit time, 1 second, it is convenient to treat that column as "unit head." Hydraulics are, however, only one form of mechanics, all of which may be related to the fall, or motions due to gravity.

16. Laws of Falling Bodies.—Gravity, as an accelerating force, generates a velocity V of 32.2 feet per second, producing, therefore, an actual motion of 16.1 feet per second. For present purposes it will be convenient to use the round numbers 16 and 32. The true "head of water" is not obtained in a vertical pipe open at the bottom, as the column is only under half the pressure due to the height; it is necessary to have a vertical supply so large in section as to allow the water to descend in it with very small "velocity," though it will, of course, represent the full "momentum," which is transferred to and retained by the water actually issuing. If in the side of this supply pipe or reservoir we have an opening of one inch circular, the water would issue from it with a velocity of 32 feet per second (ignoring any effects due to the nature of the opening). I have arranged the table of "Force of Gravity and Velocity," to show the effects of such a column.

Force of Gravity and Velocity.

Time in seconds.	Velocity.		Space Traversed.		Energy.	VI.÷16 gives ratio to unit head.	√VII. which is √Head in units.
	+ per second.	Total.	Acquired.	Per second.	Total.		
I.	II.	III.	IV.	V.	VI.	VII.	VIII.
1	32	32	16	16	16	1	1
2	32	64	32 + 16	48	64	4	2
3	32	96	64 + 16	80	144	9	3
4	32	128	96 + 16	112	256	16	4
5	32	160	128 + 16	144	400	25	5
6	32	192	160 + 16	176	576	36	6
		Momentum V×mass.	Energy $\frac{V^2 \times \text{mass.}}{2}$		Head of water. Foot-pounds.	Square of time.	Mec-mot. Force. *M*.

17. The meaning of this table is as follows:

(*a*) *Force*, when reduced to units, means one second's action, therefore the units of force exerted are *as the times* in seconds, Col. I.

(*b*) The unit force here is one generating a velocity of 32 ft., therefore we have, Col. I., times or units of force, each separately shown, Col. II., and accumulated in Col. III.

(*c*) *Momentum* is velocity × mass. Taking 1 lb. as unit mass, Col. III. gives us momentum, or quantity of motion acquired.

(*d*) *Energy* is (1) mass × space fallen, so we have the increment per second 16, added to the acquired velocity in Col. IV., showing the gain per second. Col. V., and giving the total, Col. VI.

(*e*) *Energy* is (2) mass × half the square of the velocity. This is often expressed as $V^2 \times \frac{1}{2}$ mass, but, while correct in arithmetical result, this is a misleading statement. Half mass can have nothing to do with the result, which is due to the fact that unit energy 16 is only half of unit velocity 32.

(*f*) Hence energy is as the square of the time, $6^6 = 36 \times 16 = 576$, as shown Col. VII. × 16. Now as the time = units of force (*a*), we have the evidence that the mathematical expression of force is based upon the square root of the corresponding energy. This is an inevitable result of the equality of cause and effect, although the statement may be heretical in form, because it expresses a truth, as do many heresies, in a different form from the dogmas of the orthodox.

(*g*) But *head of water* is as the "height of the column," which is also the "space fallen." Col. VI. therefore gives us "head of water" corresponding to the spaces dealt with, and dividing this by 16, the unit head or space in feet, it gives us the various corresponding data expressed in "units" in Col. VII.

(*h*) Assuming that the area of the column is such that one foot in height = 1 lb. in weight, or, generally, that 1 lb. mass is falling through the height, Col. VI. gives up by (*d*) the energy, either *kinetic* or *potential*. See §§ 12 and (*o*).

(*i*) As Col. VI. is the weight of such a column (*h*), it gives us the force defined by the static pressure exerted § 12, but it shows us that this, which I have called the "abstract force," is something different from the "force" expressed in units.

(*k*) The fundamental law of hydraulics, that is of "current" in the case of water, is that *the velocities* (that is currents) *are always as the square root of the heads.* Col. VII. gives us the "heads" expressed as units of 16 feet, therefore the square roots of these give us, in Col. VIII., the relative velocity-generating power of the several heads, corresponding to successive times in seconds, or number of units of force (*a*).

(*l*) This *square root of head*, Col. VIII., is then the same thing as the number of units of force acting, Col. I., and concentrated on the one action or mass. But it does not correspond to the static pressures of Col. VI. and VII.

(*m*) But it is evident that the two definitions of "force," § 12, must correspond. It is impossible that the mathematical formulæ, however much they may disguise the physical causes, should incorrectly represent the facts. According to the system of dimensions, attraction,

or force at a point, is $\frac{L}{T^2}$, Force is $\frac{ML}{T^2}$,

Acceleration is also $\frac{L}{T^2}$, Energy is $\frac{ML^2}{T^2}$,

Velocity is $\frac{L}{T}$. Momentum is $\frac{ML}{T}$.

That is to say, the introduction of *mass* M converts the abstract ideas or powers, acceleration and attraction, into the concrete idea of a quantity of force, and velocity into momentum, while energy or *vis viva* is the square of the space in which force is expended, which comes to precisely the same thing as the statement in (*f*) above.

(*n*) When a current of water is being actually produced, that is while the attraction of the earth is converted into dynamic force, *the pressure in the pipe would not be that shown Cols. VI. and VII.*, but would be lowered to correspond with the definitions in (*m*).

(*o*) Therefore the vertical pressure of the head of water, though it is the abstract force (*i*), is not the mathematical unit force. It gives us the *potential energy* corresponding to this force, if we consider the area of the column to be such as makes 1 ft. in height weigh 1 lb. Thus we have the potential energy in foot-pounds in Col. VI., and in units of 16 foot-pounds in Col. VII.

(*p*) What, then, is this *force* which = momentum-generating power and also = √head, and therefore of necessity = √potential energy? It is the thing described as *Mechanico-Motive Force* (§ 11), and therefore we may symbolize it by *M* in italics, to prevent the reader from confusing it with M as used for mass in the dimension formulæ.

18. But mechanico-motive force *M* is the analogue of electromotive force, E, and so also current in electricity is the analogue of momentum in mechanics, for unit quantity, as the coulomb, replaces unit mass, or the pound in momentum, and a current of electricity means so many coulombs per second, just as a current of water means so many pounds of water per second. Now, E. M. F. is the dynamic equivalent of potential, and potential (from the present point of view as *M*, Col. VIII.) is the square root of Col. VII., head in units. It is the square root of the potential energy, and here we may find the explanation of the conflicting definitions and ideas about "potential." The favorite mathematical definition is that "potential is the work spent upon a unit of electricity in bringing it from an infinite distance," which definition makes it as *the potential energy*, not as its square root. On the other hand Professor Baynes has told us that "the dimensions of electrostatic potential are those of square root of force," and my table above shows that, from the present point of view, *M* is the square root both of the static pressure before action, and of the potential energy.

19. There is in fact another way of regarding this matter, which will be dealt with in my next paper, in which *electric potential* will be found to express the *potential energy*, and *not its square root*. It is a curious consequence of the construction of Ohm's formulæ that the fundamental elements E C and R may be considered as related to energy either directly or as its square root, and *that both ways will be correct*. Apparently inconsistent, they are yet each true and useful. This is really the cause of a good deal of misconception and difficulty, and is never explained, though we may find here the reason that the symbol R in these formulæ does correctly represent both the reciprocal of conductivity, which is as C, and the work expended, which is as C^2.

20. From the point of view at present occupied, then, potential (as including both mechanico-motive force and electromotive force) represents the number of units of the artificial force of the mathematician—force expressed as a quantity—concentrated upon the act of generating a given momentum *in unit mass* or, what is the same thing, a given velocity in a defined or unit quantity. Col. VIII. of the table shows this, as the figures are the same as the "times," Col. I., which are as the units (or numbers of actions) of "force" which have been accumulated on the unit "mass" passing through the spaces of Col. VI. and VII.

21. *Current*, therefore, is in water as *M* and in electricity as E, and these we may call "potential." Now, it is evident that if a given current of water flows through a pipe of 1 in. sectional area, an equal current will flow through a second and a third such pipe, and that it makes no difference whether we use such separate pipes or unite their capacities in one pipe of two or three times the capacity. But pipes have another property besides allowing water to pass through them. They offer a resistance, a friction which absorbs energy and converts it into heat. Electric conductors have precisely the same properties, but with a difference as to the way in which energy is absorbed. In pipes this is twofold. 1. Skin, or surface friction, dependent on the nature of the pipe, varying of course *as the surface*, that is to say, as the diameter or *square root of the sectional area*. 2. Viscosity of the water itself, which necessarily varies *as the area* or mass of liquid. In electric conductors there is only a friction analogous to this latter, due to the molecular motions which constitute the current. In each case also the absorbed energy increases *as the length* and as the *square of the current*. These are the general laws of electric resistance, which it is unnecessary to enter upon here. For present purposes it is sufficient to say that the difficulty may be got over by considering conductors, not as a whole, not as a pipe or wire of such diameter or area, but as consisting of so many parallel unit conductors or pipes, in each of which similar actions occur, and having a unit length. In this manner we can conceive a conductor of unit *area* or section and length absorbing unit energy while unit current is passing.

This gives us a conductor of *unit capacity*, offering *unit resistance* to unit current, which is, in fact, the best definition of the Ohm unit.

It is obvious that the laws of transmission must be: 1, *Current* is as *capacity*; that is to say, *directly as area*, which is as d^2, the square of diameter. 2, Current is *inversely as* resistance. 3, Resistance (true) is as length and as the *square of the current*, or, which is the same thing otherwise arrived at, as the square of *M* or E (the potential).

22. The result is that current is *as* force (potential) *M* or E, and *as* conductive capacity, which we may symbolize as A, giving us C = *M*, or E × A. This is the natural truth which is disguised under Ohm's formula, C = E ÷ R. Why divide instead of multiply? *In arithmetic it is indifferent whether we multiply by a figure or divide by its reciprocal.* If we, therefore, for the moment consider R as meaning the reciprocal of A (that is 1 ÷ A), is is obvious that E × A and E ÷ R are precisely the same thing. But using the reciprocal and the division process has this advantage. We have an inverse value to employ, the true resistance, the work done in the conductor, and this is a value which the system of units expresses in the unit ohm, as the work expended in the unit conductor by unit current, which, therefore, being itself an inverse value, is directly expressed by the reciprocal of the conducting capacity.

23. Therefore the symbol *R* conveys two distinct things: 1. The arithmetical artifice of the reciprocal of capacity; and 2, the work expended by unit current; and these two are summed up in the term "resistance," as used by electricians. The result is that while the actual work, the true resistance, does increase as the *square of the current*, the formula works it out truly by the direct number, because the current itself increases as E. This embodies energy as the square of E, § 17, (*f*) and (*p*); therefore we have both cause and effect expressed by the square root of the energy related to them.

24. Here, then, we have the explanation of the common statement that electric resistance is equal for all currents, that is to say, an ohm is 1 ohm resistance for 1 ampère or 20. This, the first statement quoted, § 3, applies to the arithmetical value, the reciprocal; *for a unit conductor, pipe or wire has the same capacity for all currents;* that is, it will permit 1 unit current to pass under 1 unit force, or 20 under 20 units, § 21. But none the less it will, *for both water and electricity*, retain, in Mr. Siemens' words, "a certain amount of energy proportional to that transmitted;" and that is, *for electricity exactly as for water*, in the ratio of the "square of the velocity of flow." I have dwelt so fully on this subject because I have found that it is a great difficulty to most people, and because all electrical books dwell upon the artificial formulæ and never explain the natural truth which underlies them, and which, in consequence, they replace.

25. Hydraulic Analogy of Current.—As stated, § 21, it is difficult to present water pipes so as to perfectly correspond with electric wires. It is also impossible to work out water currents by a formula corresponding to Ohm's, when treating them as derived from head of water, or as familiar to us in the network of water supply pipes. In this case the water itself runs away, but the electricity does not, and carries energy with it, while with electricity the energy is wholly *in the circuit*. Consequently in water-works the force has to have two expressions, one for the work done in the pipes and the other for the issuing velocity, which has no analogue in electricity. But there exists a much closer analogy in the case of an hydraulic system for doing work, such as actuating the cranes in a dockyard. Here we have a closed circuit in which the water circulates, closely resembling the electric circuit, in which the engine and pump correspond to a galvanic battery. Even here the conditions of resistance or friction are not quite analogous, but the relations of force and circuit are identical. The same "quantity" passes at every section, large or small. The current can be made to transmit very different energies and do very different work, and that according to the pressure, whether in lbs., per inch, or in volts. Nor has electricity any of the advantage claimed for it over water in transmitting energy in consequence of any difference in the principles in operation.

26. Electricity becomes more economical as the potential

is increased. So does water. The limit with electricity depends upon the difficulty of insulation, and the danger of high tensions. It is exactly the same with water, for the strength of the pipes and the danger of bursting them are the exact counterparts of the insulation difficulties. The real advantage is a practicable one; the limit of safety has a far greater range with electricity, and its generators and conductors are more simple and manageable than hydraulic machinery and pipes, and are not exposed to risks of freezing, against which, however, may be set the danger of overheating the conductors.

The Strike.

At the time THE ELECTRICAL WORLD goes to press the indications are that the telegraphers' strike cannot last much longer, and that the operators will be compelled to return to work on the company's terms. We share the disappointment experienced by the strikers, because we believe they have not been paid salaries commensurate with the important and responsible nature of their duties. They have made a good fight, and have maintained their ranks with admirable unanimity. Unfortunately for them, however, the Western Union Company also has kept up a steady and determined front, and, with the superior aids to endurance at its command has been able, as it seems, to starve a large proportion of the strikers into a return to work. While these have not been able to gain the concessions for which they asked specifically, we believe that one effect of their action will prove to be a material increase of the remuneration paid them. The company can better afford to pay higher wages continuously, and to have a contented staff of operators, than to bear the friction and loss inseparable from a strike by their employés.

A review of the incidents of the week does not present many which need to be recorded here. They are generally of a minor character, affording little more than passing gossip to scribblers for the morning and evening papers; but those which we think proper to present are of exceptional importance.

At a meeting on Sunday, held in New York City, and attended by representatives of forty labor unions, it was decided to stand by the strikers. Systematic work was at once begun in the way of raising "the sinews of war" for the use of the men out, a commendable interest in the matter being shown by persons in all ranks of society. On Wednesday evening the Finance Committee of the Brotherhood received a contribution of $1,000 from the Brown-Stone Cutters' Union, and several smaller amounts from other labor organizations.

More or less apocryphal accounts have been published since our last issue of the cutting of wires in this and other cities. On Tuesday Superintendent Scott, of the Gold & Stock Telegraph Company, said that 126 wires of the company, which run in the form of seven cables from the Western Union Building through Church to Rector Street, had been severed. This, whether true to the extent stated or not, caused great inconverience at the exchanges and offices of bankers and brokers on a day exceptionally exciting, and when every item of news had greater value than ordinary. Whoever committed this act, and others of a similar character, is deserving of unreserved censure, and this, we are happy to state, is the view taken of the matter by the officers of the Brotherhood. When, at a meeting of the New York assembly, held on the 11th inst., some striking linemen advocated the cutting of wires as an indirect assistance to the cause they had in common with the operators, their proposition to adopt the plan suggested was voted down with a promptitude and emphasis very nearly akin to indignation. We are thankful to state that there are no evidences at all that the commendable moral elevation of the telegraphers' cause has been prejudiced during the long and sometimes depressing experiences of the past month. Patient and law-abiding, their spirit deserves the admiration which it certainly commands.

The Western Union Company showed extraordinary address in its move of the 14th inst., having reference to this matter of cutting wires. On the day stated General Superintendent A. S. Brown presented the following to Mayor Edson:

The Hon. Franklin Edson, Mayor of the City of New York:

SIR: In pursuance of the statute, of which a copy is hereto annexed, you are respectfully notified that a riotous body of men are threatening to destroy or injure the telegraph lines of this company in various places in the city of New York. This Company has used, and is still using, all possible diligence to prevent such damage, but will be obliged to look to the city of New York for reimbursement for such losses as may be sustained beyond its power to prevent.

WESTERN UNION TELEGRAPH COMPANY,
By T. T. ECKERT, Acting President.

This was followed by a copy of Chapter 428 of the Revised Statutes, passed April 13, 1855, and entitled "An act to reimburse parties whose property may be destroyed by mobs or riots." So much of it as is alleged to apply to the case in point provides that any person or persons whose property, real or personal, may be destroyed or injured by the illegal acts of mobs or rioters may, after due notice be given, bring action against the mayor of any city or sheriff of any county to recover any losses sustained after such notice is given. It also provides that these officers shall be empowered to collect such damages as are awarded, after due proof, from the treasurer of the city or county. After having received these documents Mr. Edson conferred with Mr. Andrews, Corporation Counsel, and Mr. Walling, Superintendent of Police. Upon his return to police headquarters the last-named gentleman summoned the commanders of all precincts before him, and, having directed their attention to the cutting of the telegraph wires in various parts of New York, instructed them to employ the greatest diligence in order to discover offenders in the manner indicated and to prevent a repetition of the same. He ordered them, moreover, to have a reserve force in each station-house to be at the disposal of any telegraph company needing their services for the protection of their linemen and property. Central office detectives likewise received special orders on the same subject, and some of these were promptly detailed to watch in different parts of the city for offenders against the integrity of the wires.

On Monday the sub-committee of the United States Senate Committee on Labor and Education began in this city the taking of testimony with regard to the strike. John Campbell was the first witness, and other prominent officers of the Brotherhood were examined, and officers of the Western Union and other companies will be. This investigation will unquestionably benefit the strikers' cause, because the more light is thrown upon it, the more strongly appears its inherent justice.

Wednesday was one of the most momentous days since the commencement of the strike. Its developments as to the strike illustrated, on the one hand, a characteristic arrogance on the part of a leading representative of the Western Union Company, and, on the other, the firmness, dignity and modesty of the men on strike. These, acting through a committee of five representatives, sought to make a peaceful arrangement with the company, and were dismissed by General Eckert, as reported in the New York *Herald*, with: "I think the best thing you can do is to see the District Superintendent. I do not know of any vacancies at present, but operators who went out recently, on applying for re-employment may, if their records are found to be good, be reinstated in the employ of the company." And this insolent speech was addressed to representatives of the ablest operators in the world, the men the best qualified to adminster a public convenience of the highest utility. The response of the Brotherhood, by order of the executive board, and signed by John Campbell, D. M. W., is a document most admirable in both its spirit and expression. General Eckert's treatment of the strikers, although approved by the directors of his company, contrasts very unfavorably with their bearing throughout an interview of a painfully disagreeable character, and which culminated in the conclusion, expressed in Mr. Campbell's letter to "Mr. Thomas T. Eckert, General Manager and Acting President Western Union Telegraph Company," as follows: "Since all of our attempts to effect a reconciliation have proved futile, we now desire to state that it is the intention of the members of the Brotherhood to ignore your ultimatum and carry on the fight with renewed vigor and determination by every legitimate means in their power."

Since Wednesday the company has insisted upon all the men to whom it gives employment signing an agreement, (1) That they renounce all allegiance to the Brotherhood; and (2), that they solemnly promise not to join any organization which will undertake to dictate to the company the wages it should pay to its employés. This is a free country!

The Best Place to Seek Shelter During an Electric Storm.

The Boston *Traveler* has this to say on the subject: As this is the season for the play of aerial electricity, and as the human body is a good conductor for the fluid, it becomes every one in a heavy thunder shower to seek a place of safety. A thunderbolt, though seemingly at "the sport of circumstance," does move really in obedience to most perfect law. In descending from a surcharged cloud it seeks the nearest and the best conductor. It makes a zigzag movement through the air, because this element is a bad conductor, and does all it can to resist the intruder. The fire of the bolt itself is but the consequence of its battle with the air through which it fights its way. Sometimes a bolt passes from one cloud to another, and then the thunder peal is one long-continued reverberation. But when a bolt strikes the earth the peal is sudden, solid, sometimes deafening. As sound travels at the rate of 1,120 feet per second, and light with such velocity that we need not here consider it, the distance between the observer and the point struck by the bolt may readily be estimated. It is done by counting the seconds intervening between the flash and the report. Thus, if ten seconds elapse the distance is 11,200 feet; if thirty seconds, or half a minute, 33,000 feet. In case of near and heavy discharges of electricity it is always unsafe to stand beneath a tree, because it is a good conductor, or near a large rock, or mass of iron, or body of water, for the same reason. It is also unsafe to stand in an open field at a considerable distance from any prominent object which might serve as a protector. If alone in such a place, it were well in an electric battle to draw near, but not too near, to some rock, or tree, or body of water which would be likely in your stead to take the bolt. Refuge in a barn, especially when filled with hay and grain and cattle, should always be avoided; if in a house in a heavy thunderstorm, the doors and windows should be closed, for lightning tends to follow an atmospheric current, and hence so many persons are killed while standing in a doorway or while sitting at an open window. When lightning strikes a dwelling-house, it usually goes down the chimney or corner of the building, runs along the walls, taking bell wires, looking glasses, lamps and other metallic articles in its course. Hence it is always dangerous, when the storm is near, to remain in the corners of a room, or to rest against the walls, or near a stove, or lamp, or looking-glass, or, indeed, any good conductor of electricity. A tall tree standing close by a dwelling-house serves as a kind of lightning-rod; yet, sometimes, the fluid leaves the tree as it does a rod and enters the building; hence rooms thus exposed should be vacated till the danger ceases. Perhaps the safest place in a terrific thunder-storm is on a hair or feather bed in the centre of a room well closed, and without a fireplace or much metallic furniture, in the lowest division of the house. But if the room be carpeted, a chair in a similar situation affords comparative safety.

T. M. B. A. Amendments.

The following are proposed amendments to the Constitution and By-Laws of the Telegraphers' Mutual Benefit Association:

NEW YORK, August 1, 1883.

To the Secretary Telegraphers' Mut. Benefit Association:

DEAR SIR.—I propose that the following changes be made in Constitution and By-laws.

1. Strike out Section VIII. of the By-laws and substitute therefor the following:

"Section VIII.—Upon the death of a member in good standing, the secretary shall levy the following assessments, when directed so to do by the Executive Committee.

Age at admission.	Assessment.
18 to 30	$1.00
30 " 35	1.10
35 " 40	1.25
40 " 45	1.50

—provided, however, that this amendment shall in no manner affect or change the amount to be paid at each assessment by those who became members prior to the adoption hereof. In case assessments have not been paid within thirty days of the date of levying the assessment the delinquent shall forfeit all claims to the benefits of the association, and should payment not be made within sixty days from such date, the delinquent shall forfeit membership, to which said delinquent can be restored only as provided by the Constitution and By-laws."

2. Strike out Section XXV. of the By-laws and substitute the following:

"When official notice has been received of the death of a member in good standing in the Second Division, the Secretary shall levy the following assessments upon the members of the Second Division when directed so to do by the Executive Committee:

Age at admission.	Assessment.
18 to 30	$1.00
30 " 35	1.10
35 " 40	1.25
40 " 45	1.50

—provided, however, that this amendment shall in no manner affect or change the amount to be paid at each assessment by those who became members of the Second Division prior to the adoption hereof.

"In case assessments have not been paid within thirty days of the date of levying the assessments, the delinquent shall forfeit all claims to the benefits of the Second Division of the Association, and should payment not be made within sixty days from such date, the delinquent shall forfeit membership in said Division."

3. Insert the following as section XXIII. of the By-laws, making the necessary changes in the numbers of the following sections.

"Any person who has forfeited membership in the Second Division through non-payment of assessments may be restored upon payment of a fee of three dollars, provided the applicant for restoration shall furnish the Executive Committee, if required, with a satisfactory medical certificate of health and is in good standing in the First Division of the Association.

F. W. JONES and 27 others.

AUGUST 10.

PROPOSED AMENDMENT TO SECTION XIV. OF BY-LAWS.

Owing to the large increase in the reserve fund, and in order to throw around it additional safeguards, I propose to so amend Section 14 of the By-Laws as to make it read as follows, viz.:

The Reserve Fund, to the amount of not exceeding $35,000, shall be held for the Association by the Western Union Telegraph Company as Trustee, and the balance of the Reserve Fund shall be held by such Trust Co. in New York City as the Executive Committee, by a three-quarter vote of all its members, shall select, as Trustee, and said Trustee shall deliver no part of said Reserve Fund without consent of two-thirds of the Executive Committee, to be entered upon its minutes; such record to specify the amount to be delivered, and the object for which it is to be used, and from which Trustee it shall be drawn. Upon receiving a properly certified copy of such record, the said Trustee is authorized to deliver to the Treasurer of the Association the amount required and to charge the same against the funds in its custody. No part of the Reserve Fund shall be used excepting as provided in Section XIII. of these By-Laws.

S. M. TAYLOR and 26 others.

Printing by Electrolysis.

The applications of electricity are multiplying in consequence of the earnest inquiry and untiring experiment as to its nature and capabilities which distinguish the present age. We are not able to state the name of the paper in which the following interesting paragraph first made its appearance, but give it place because it contains an intelligent account of what promises to be a most useful advance in the industrial arts.

The familiar chemical telegraph has been for some time almost the only useful application of the staining or discoloring effects of a current of electricity. The ribbon of paper in the chemical systems of telegraphy is saturated with certain chemicals, and when the current passes through the paper, the solution is reduced and a blue stain is made on the paper. It is now proposed to use printing blocks in place of the needle-point used in the telegraphic instruments, and to print designs, letters and patterns on cloth and paper by electrolysis. From the experiments already made, it appears that the fabric is impregnated with a solution of aniline salt, and is then placed on a metal plate that is connected by wire with a dynamo-machine. Another plate containing the lettering or pattern in relief is to be produced on the paper is also connected with the dynamo, the two plates forming a circuit. When the printing-plate is laid on the paper under some pressure the circuit is closed, and the current passes from one plate to the other through the paper, the salt is reduced, leaving a permanent stain in aniline black in the exact form of the type or pattern on the paper. By substituting a carbon pencil, held in the hand by an insulated sleeve or handle, writing in black can be traced on the paper by means of the current. This last plan is thought to be likely to prove of great value, as the markings are in indelible black, or in a number of other permanent tints. Another plan is to use engraved rolls that form a part of the electrical circuit, and to pass the fabric between them while the current is passing. By a reversal of the system bleaching has been accomplished. Fabrics dyed indigo blue or Turkey red, impregnated with a solution of saltpeire, have been bleached out white by passing them between rolls that are in an electrical circuit, or under a press having type or a raised pattern and in a circuit. Whenever the current passes the color is destroyed, leaving the fabric white. In passing such a press, the colored fabric has a pattern picked out in white upon it. The process, both in printing in black or colors, and in bleaching dyed fabrics, is believed to promise a method of producing printed, or, more properly, stained fabrics of great sharpness and clearness of design, and in new shades of color.

THE TELEGRAPH.

Cable Lines to be Repaired.—A dispatch received from Ottawa, Ontario, on the 14th, says that the captain of the government steamer Newfield, now on the way to Halifax from Pictou, has received instructions from Ottawa to lay the Cape Sable Island cable to the main line, and also to proceed to Grand Manan to repair the cable there, which has been out of order for some time.

The Southern Telegraph Company.—This company is making rapid progress in its work of construction. The line from Charleston to Columbia, S. C., and that from Charlotte will soon be completed to Columbia. Gangs of hands are at work erecting poles from Columbia to meet the forces coming from those places. The office in Columbia will probably be the receiving and distributing point, holding the same relation to the business of the company that Augusta, Ga., holds to the Western Union.

Bankers and Merchants' Telegraph Company.—It is reported that the business of this company has increased 150 per cent. since the strike. It is stated further that six additional wires are to be constructed between New York and Washington within the next 60 days. The recent issue of $300,000 of 30-year 6 per cent. bonds on the present line between New York and Washington is reported all taken. The company has declared a dividend of 6 per cent. payable Sept. 10. The proceeds of the $300,000 of first mortgage bonds recently authorized by the company are to be used to put up 12 additional wires between Boston and New York.

Promotion.—On Saturday last Mr. William H. Dillon, traffic chief at the Philadelphia Western Union main office, was made chief operator to succeed Mr. John D. Clarke, promoted to the managership of the W. U. office at Washington, D. C. This is a well-deserved compliment to a very worthy young man and an excellent operator. With Superintendent Zeublin and Manager Jones the Philadelphia district had, up to the time of the strike, attained a degree of matchless efficiency both for discipline and that cordial good feeling between the men and the management which is so essential to good work, and we see in this promotion of Mr. Dillon a guarantee of a similar state of affairs when the normal conditions shall have been resumed.

Pennsylvania vs. the Western Union.—On the 14th inst. the Western Union Telegraph Company filed in the United States Circuit Court, Philadelphia, its demurrer to the suit brought by the Commonwealth of Pennsyluania for over-reaching its legal rights in consolidating with different competing companies and monopolizing the business of telegraphy in that State. The demurrer was prepared by counsel for the company, Benjamin Harris Brewster, Attorney-General of the United States, being one of the number. It sets out that "not confessing any or all of the matters and things in the Commonwealth's bill to be true in the matter and form set forth, the defendant demurs to the whole of said bill and for cause of demurrer showeth: That the complainant has not, in and by its said bill, made or stated such a case as does or ought to entitle it to any relief from or against this defendant touching the matters contained in the said bill, or any such matters; that the said complainant is not entitled upon said bill to the relief prayed for, because it has a plain, adequate, and complete remedy at law; therefore, and for divers other good causes of demurrer appearing in said bill, the defendant demurs thereto, and to all the matters and things contained therein, and prays the judgment of the honorable court whether it shall be compelled to make any further or other answer to the said bill, and humbly prays to be hence dismissed with its reasonable cost in this behalf sustained."

THE TELEPHONE.

The Telephone in Tennessee.—The stringing of the telephone wire from Ashley to Nashville, Tenn., a distance of ten miles, was completed on the 5th inst. Nashville is now in telephonic communication with Ashley, Mount Vernon, Centralia, Richview and various other points.

The Telephone at Pottsville, Pa.—The Eastern Telephone Company of Pennsylvania has completed its arrangements for longer circuits. Pottsville has now direct communication by telephone with nearly every important point within a radius of sixty miles, and the company contemplates a still further extension of its lines.

Bell Telephone of Missouri.—This company continues to display energy in the extension of its lines. Lebanon, Ill., was brought into telephonic communication with Belleville and many other towns in St. Clair County on the 6th inst., and mutual congratulations were exchanged with Belleville O'Fallon. Freeburg, French Village and Caseyville.

Telephone Extension in Pennsylvania.—The Eastern Pennsylvania Telephone Company on Aug. 9 finished the connections between Pottsville, Pa., and intermediate points on the east and Shamokin and Sunbury on the north and west. Pottsville is now telephonically connected with every city and important town within a radius of sixty miles, and the lines are being still further extended.

Telephone Extension in Ohio.—The Midland Telephone Company on Aug. 9 completed connections between Wapakoneta and Sidney on the south and Lima on the north. A through line of communication is now established between Cincinnati and Toledo. The Wapakoneta Council granted the right of way through the town in consideration that an office be established in that place by the company.

More Consolidation.—The Ohio Telephone Company has bought the property and effects of the American District Telephone Company of Louisville, Ky. At the last meeting of the stockholders, the following gentlemen were elected to office: President, J. B. Speed; Treasurer, James Clark; Secretary, W. H. Mundy; General Manager, H. N. Gifford. The capital of the consolidated company is $400,000. It is projected to build lines to Cincinnati, Nashville and Indianapolis.

Springfield, Ill.—The telephone exchange in this city now ranks third in the State in size and importance, Chicago, of course, being first, and Peoria coming next. It is estimated that the Springfield exchange will have 500 subscribers in the near future. Through wires are being erected between Springfield and Jacksonville, Decatur, Lincoln, Bloomington, Peoria, Petersburg and other adjacent cities. These lines will have no intermediate stations, an arrangement that will greatly facilitate communication between the points named.

Extension in Illinois.—Toll lines have been built recently from Elgin to Rockford, and from the same city to Woodstock and Howard, thence to connect with Lake Geneva. These, with connecting lines running into the exchanges mentioned, give the whole Northwest connection with Chicago *via* Elgin. No. 6 wire is being used. Toll connections are worked direct 130 miles without difficulty or repeating.

A Real Grievance Humorously Expressed.—If anybody deserves an increase of pay it is the fellow who scales your high wall, nails his telephone wire to your roof, chuckles in his boot-legs, and strides off without so much as "If you please" or "Thankee." He ought to have 25 per cent. extra. When people begin to shoot the work will be worth 50 per cent. more.—*Wheeling Intelligencer.*

Price of Bell Telephone Stock Advancing.—The public, it would seem, have already begun to look at the telephone situation and its probable effect on stocks pretty much as we explained it in last issue. In that number we chronicled the fall that had just taken place in telephone shares, especially American Bell. We learn, however, from the Boston papers that Bell telephone stock rose almost as sharply on Thursday of last week as it declined on Wednesday, starting at 225 and rising to 240 without a check. The heavy drop of the preceding week brought in buyers. The Bostonians argue in this way. The People's Company may become formidable in time, but unless the lawyers and money give out, the Bell is liable to have the full benefit of its 17-year patent before the courts are through with the points in dispute. It is a great misfortune for Mr. Drawbaugh that the genius of the inventor and wealth of the capitalist were so slow in finding each other out, always supposing that the priority of invention rests with him, as is claimed by the People's Company.

The Telephone and Sore Ears.—"When a telephone hangs where everybody in an office uses it," a sensitive man wrote to the Chicago *Tribune*, "it is like all the boarders in a boarding-house using one toothbrush. In our office one of the clerks had a sore ear. He, among the rest, used the telephone, and now eight out of the eleven persons in the office are similarly affected." In order that the truth or falsity of the statement contained in the communication of the sensitive man might be established, a *Tribune* reporter visited the office of the telephone company. The gentleman in charge said the idea that eight persons should contract a disease from a telephone was not only preposterous but silly. The reporter called upon several eminent physicians. The unanimous opinion was that it was utterly impossible for any disease of the ear to be spread by means of the telephone. Certain portions of the ear were as sensitive as any other portion of the body, but it was impossible for those delicate members to come in contact with a sore ear or a telephone that had had contact with a sore ear.

People's Telephone Company of New England.—At a meeting of the incorporators of the People's Telephone and Telegraph Company of New England last week the following directors were chosen: Hon. Frank Jones of Portsmouth, N. H., ex-Gov. Abner Coburn of Skowhegan, Me., Col. Darius Alden of Augusta Me., Payson Tucker of Portland, general manager of the Eastern & Maine Central Railroad, J. R. Bodwell of Hallowell, ex-Gov. Horace Fairbanks of St. Johnsbury, Vt., Hon. J. G. Abbott of Boston, Hon. F. O. Prince of Boston, S. C. Blanchard of Boston, James P. Cook of Salem, Mass., William. H. Pope of Providence, R. I., John W. Slater of Providence, Hon. Thomas M. Waller, Governor of Connecticut, Hon. George H. Watrous, president of the New York & New Haven Railroad, and Marcus Marx of New York. At a meeting of the directors, the officers were elected as follows: President, Hon. Frank Jones; Vice-President, Hon. J. G. Abbott; Executive Committee, Messrs. Jones, Fairbanks, Watrous, Abbott and Pope; Treasurer, S. C. Blanchard, Secretary, H. M. Cross.

The Mexican Telephone Co.—This company, the headquarters of which are now in Boston, at a meeting of stockholders held in this city Aug. 14, voted to increase its capital from one to two million dollars. A Boston syndicate has taken 25,000 shares of the increased stock, paying in cash $2 per share. The other 75,000 shares remain in the treasury, to be issued when expedient. After the bills due by the company shall have been paid, the handsome balance remaining of the $50,000 raised by the issue of shares as stated will be placed in the treasury. The officers of the company have also been changed and are now as follows: Messrs. F. B. Beaumont, of Boston, president; Wm. Reed, of Boston, treasurer, and F. E. C. Bryant, of the same city, secretary. Messrs. Reed and Bryant have been added to the list of directors. The ex-president, Mr. Delano, is still a director. The officers of the company express themselves as highly satisfied with the condition of the company, and anticipate for it a prosperous future. They say, judging from the present and past receipts, the orders on hand, and the general outlook for the future, that they can see no reason why the stock will not become dividend-paying by this time next year. In future all additions to the plant will be paid out of the treasury. The entire receipts, excepting only the working expenses, will be devoted to paying dividends.

The Tropical Company.—The Boston *Herald* of August 10 says: At the first meeting of the directors of the Tropical American Telephone Company since the stockholders' meeting, July 25, just held, it was shown that, with the exception of two or three islands in the West Indies and British, French and Dutch Guianas in South America, all the company's territory was either leased to sub-companies or was being developed by the Tropical direct; that the company had established a self-supporting and paying exchange at Barbadoes, and was establishing another at Trinidad; and that the earnings from the one at Barbadoes would, with the exception of instruments and apparatus to be furnished, support and pay for the one at Trinidad. The sub company stocks held by the Tropical not yet yielding any revenue, its source of income had been entirely from profits on sales of instruments and apparatus to sub-companies, under existing contracts, which provide for further and continued orders. The prospects of the company on the present basis of management appeared to be encouraging for increased earnings. The treasurer's report showed in brief that, after paying all expenses and debts, and charging of all items of doubtful character, the net profits of the business amounted to 6 per cent. on the capital of the company, figured at $3.00 per share. The company will start its second year of business with considerable cash in the bank, no debt and 5,000 shares of stock in its treasury.

An Incident of Telephone Life in Chicago.—"Supt. Baldwin was down on South Water street setting up the wet groceries in the most lavish style. Friday afternoon Mr. Baldwin, who had been informed that the telephone leading into the crib was out of order, boarded a tug and rode out there to attend to the repairs. The telephone proved to be worse than he had suspected, and as he had not notified any tug to call for him he found himself likely to stay there, hidden from this wicked world for a month or so. He was somewhat encouraged to learn from the keeper that the provision-box was well filled, and that there was a certain black jug in a certain dark corner which would serve to revive his sinking spirits. This was not bad. But it is a lonesome place with nothing to do. The splashing of the waves and an occasional sail are the only things to vary the monotony. Several attempts were made to hail passing vessels, but the signal escaped attention. The signal was a white shirt hung on the end of a fishing pole. Night came on, and black-looking objects with spires and domes supposed to mark the site of the city became blended with the many fires that illuminate the streets. The signal light of the crib was hoisted, but still no vessel responded. Yesterday afternoon, after Mr. Baldwin had been away from his family for more than forty hours without any explanation, the tug Prindiville, which had finally been attracted by the signals, landed him safely on South Water street. He said he felt as if he had been released from the tomb, and proceeded at once to celebrate his resurrection by asking the boys in to take something."—*Chicago Times.*

THE ELECTRIC LIGHT.

Electric Light in the South.—A Columbus, Ga., company, with $100,000 capital, will electrically light that city.

A new Company in Maine.—The American Electric and Illuminating has organized another sub-company, this time in Portland, to be called the Consol dated Electric Light Company of Maine. It is to be controlled by Maine capitalists and operate in the leading cities of Maine.

The Electric Light in Quincy.—We learn from the company that as a result of the competitive trial of the various electric arc lights given at Quincy, Ill., last February, the city anthorities have contracted with the Thomson-Houston Electric Co. to use their apparatus to light a considerable portion of the city.

Electric Light For Lighthouses.—An extensive laboratory, to be supplied with the best modern electrical appliances, will soon be erected at the lighthouse depot at Tompkinsville, Staten Island, where varied and elaborate tests will be made, under supervision of experienced electricians, to ascertain the practicability of introducing electric lights in the Government lighthouse service.

Electric Light in an Infirmary.—The electric light is used in the general infirmary in Vienna, which is provided with both a portable and fixed lamp in every ward. As the cost is greater than would be incurred by the use of gas, the substitution of the electric light in places devoted to the sick is not likely to be generally followed, although preferable, especially in hot weather.

ELECTRIC LIGHT FROM SAWDUST.—The Lehigh Valley Railroad Company have, in their extensive yard at Packerton, Penn., a plant of forty electric lights and five dynamo machines, lighting an area of nearly four miles in length. The power for this plant is provided by a large double engine, which is used in the day-time to run their large shop machinery, the only fuel being sawdust and refuse from the carpenter shop.

ELECTRIC LIGHTING OF LONDON.—Sir. Frederick Bramwell stated recently to a select committee of the House of Commons that he believes the Edison company could supply the electric light in the Strand district of London, as cheaply as any company; and Sir. J. Lubbock, Chairman of the Edison company, mentioned the sum of twenty thousand pounds as that proposed to be paid Mr. Edison in anticipation, in case the contract was awarded to the company named after him, and half profits after five per cent. had been paid to the shareholders; from which it appears that if the Edison company gets the job to supply the Strand district our capitalist inventor will make a good thing.

ELECTRIC LIGHT AND FEMALE BEAUTY.—"Nobody," says Nym Crynkle, "appears to have noticed one effect of the electric light—it is going to make brunettes fashionable again. The white glare is, in a color sense, death to the blonde. The pinkest of them take on little shadows under the eyes, and purple tints come into their lips, and their cheeks get ashen. I am speaking now of a natural blonde. The effect upon the artificial bleacher is simply cadaverous. But the brunette sparkles under it like the evening star. What a dreadful state of existence the dear enameled will lead when they can neither go out at day or night! I suppose you know the hot sun heats the faces of enameled women, gets hot to blister the flesh underneath, which would split the artificial covering. If, then, the electric light shuts them in at night also, they might as well be enameled all through in the old Egyptian style, put into a sarcophagus."

THE AMERICAN ELECTRIC AND ILLUMINATING COMPANY has taken a lease of the large store and basement at 234 Devonshire street, Boston, which it will occupy September 1 as an office and wareroom. The company's business has increased to such an extent that it finds the need of enlarged quarters for the transaction of its office business very pressing, and it has long felt the want of a suitable storeroom in which to keep on hand a supply of dynamos, lamps, wire, insulators, carbons and other supplies constantly needed by the numerous lighting plants which it has established, as well as by others in process of construction at the present time. The quarters which have been secured are admirably adapted for the purpose, having ample vaults and excellent elevator facilities, while the location is central and on the main thoroughfare of communication between the northern and southern depots. The fitting up of these new quarters will begin at once.

DYNAMO-ELECTRIC MACHINES.—Herr Brunner, superintendent of the Austrian telegraphs, recently delivered a lecture on dynamo-electric machines, in which he expressed the opinion that the entire science of engineering is being revolutionized. Dynamo-electric machines, he said, not only converted the power of a rotating motion into electricity, but they are able also to reconvert electricity into working energy. As the most perfect solution of this problem the lecturer spoke of the machine put up at Munich by Marcel Deprez, which conveyed the power produced by a steam-engine at Meisbach, to Munich, a distance of 35 miles, by means of an ordinary iron telegraph wire. On this subject Herr Brunner spoke in the following words: "It would be difficult to overrate the importance of this invention. By it coal is, or will be, superseded. In future it will be possible to turn the power of waterfalls to account from the very source, while at this moment these streams run away unused. Every drop of them may be gathered up in turbines, which set dynamo-electrical machines in motion. These in their turn carry the accumulated energy via a telegraph wire into a factory, where it is turned to account for working the main shaft or lighting the work-rooms. Lastly, there will be nothing out of the way for turning electric energy to account for domestic uses, such as getting up stairs, working a sewing machine, washing, ironing, etc., nay, even a piano might be played by electricity."

MISCELLANEOUS NOTES.

PATENTS.—Last week three hundred and ninety-five patents were issued from the office at Washington. We suppose Edison got all but two of them. The other two are for things that nobody can ever use.—*Burlington Hawkeye.*

ELECTRICAL CONDUIT CONSTRUCTION COMPANY.—This company was incorporated by a certificate filed in the County Clerk's office, New York, on the 15th inst. Its purpose is to make and sell electrical conduits and underground conductors of electricity. Its corporators are D. N. Hurlbut, of Illinois, and S. F. Kneeland, Charles A. Brown, W. H. Fairbank, A. B. Chandler, H. W. Pope, and Elisha Gray. The capital stock of the company is fixed at $1,000,000, and its shares at $10 each.

THE TELEPHONE AND ELECTRIC LIGHT IN TUNNELING.—The New York *Herald* of Sunday contains an illustrated article on the Hudson River Tunnel, which in fifteen months' time will form a practicable connection between New York and Jersey City. Mr. S. H. Finch, the chief engineer of the work, has in use a telephone connecting the tunnel with his office. The electric light is employed in the illumination of the works, which, when completed, will be a masterpiece of engineering.

UNDERGROUND WIRES IN NEW YORK.—The New York Sectional Electric Underground Company has been incorporated, with a proposed capital stock of $2,500,000. Joseph B. Ecclesine, jr., William S. Taylor and H. Stevenson Beattie, of New York, and William H. Stevenson, of Philadelphia, filed the certificate of incorporation. The proposed general route of the line of telegraph proposed to be laid by the company is from the junction of Broad and Front streets, north through Broad street to Wall street, through Nassau street to Chatham street, to the Bowery, to Fourth avenue, to Seventeenth street, to Broadway, to Thirty-fourth street, up Sixth avenue to Fifty-eighth street, to Ninth avenue, to One Hundred and Tenth street, to Eighth avenue and to the Harlem River at McComb's dam. In addition, it is proposed to have branches, parallel routes and cross lines in most of the principal streets and avenues. We learn that permission from the authorities to lay the wires has not yet been obtained, but no difficulty in the matter is anticipated.

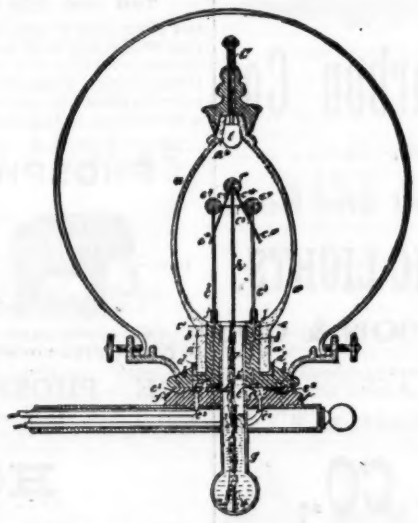
STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Thursday of last week and Thursday of this week as follows:

	Aug. 9.	Aug. 16.
American Cable	66	65
Bay State Telephone	132	....
Bell Telephone	223½	229
Currier Telephone Bell Co	20	....
Granite State Telephone	85	85
Mexican Telephone Co	2	2¼
National Bell Telephone of Maine	78	79
Suburban Telephone Co	....	125
Tropical Telephone	....	2
Western Union Telegraph	79¼	73⅛
American District Telegraph	28	....
Bankers and Merchants' Tel	....	139
Long Island and New Jersey Telephone	100	....
New York and Pennsylvania	90	90
Boston & Northern Telephone	132	115
Union Telegraph and Telephone	100	....
Erie Telephone	....	58
United States Electric Light	121¾	....
Edison Electric Light	....	225

ELECTRICAL PATENTS ISSUED

And Dated August 7, 1883.

Battery box or vessel; Eli T. Starr, Philadelphia 282,795
Conduit for electric conductors; Lamuel Bannister, Philadelphia 282,833
Electric gas lighting and extinguishing device; Le Roy S. White, Waterbury, Conn 282,816
Electric gas burner; Charles H. Hinds, New York 282,890
Electric circuit breaker; Samuel M. Plush, Philadelphia 282,921
Fixture or bracket for electric lamps; Charles W. Holtzer, Brookline, Mass 282,521
Galvanic battery; E. F. Schlosser, Hoboken, N. J 282,784
Incandescent electric lamp; E. R. Knowes, Brooklyn, N. Y 282,534
Lightning rod; Theodorus H. Patee, Greencastle, Ind .. 282,562
Machinery for covering telephone and telegraph wires, etc.; John Alexander Sparling, London, Eng 282,680
Manufacture of incandescent electric lamps; John H. Guest, Brooklyn, N. Y 282,884
Telegraph pole; Thomas Breen, Knowlton, Pa 282,489
Telephone central office apparatus; W. M. Brock, Shamokin, Pa 282,699
Telephone cabinet; Richard Busteed, Brooklyn, N. Y .. 282,841
Incandescent electric lamp; Paul Ragoul de Faucheux d'Humy, Clapham Rise, Surrey Co., England 282,861



The base of the lamp has a vessel *g*, containing a hydrocarbon. The filament, or loop, is made of sticks or tubes of metal or other material extended upward from the conducting wires and connected at the top by a cross piece, a small globe of carbon and graphite or like material being fitted to these wires at their upper ends. In order to increase the life of the loop other pieces are connected to the vertical portions and joined by a third carbon globe at the top. No vacuum is primarily produced in this lamp. The strip *h* conveys heat to a wick dipping in the hydrocarbon liquid and causes vapor to arise therefrom. As soon as this has replaced the atmospheric air in the bulb of the lamp, it is sealed. Then, in the continued working of the lamp, the carbonaceous vapor will continuously deposit a thin layer of the carbon on the incandescent filament wire, stick or tube c^6 c^7 c^8 c^{10} and on the carbon globes c^9 c^{11}, and thereby for a long period prevent the destruction thereof, while the hydrocarbon vapor in the globe or bulb *a* will also assist in such operation.

The vessel *g* may be raised or lowered so as to provide the proper supply of carbonaceous vapor. The glass globe *a* can also be removed from the cylindrical insulator *b* so as to permit of cleansing or repairing the lamp.

Claim. 1. The combination, in an electric lamp, of the vessel *g*, insulator *b*, supporting the vessel, a suitable globe fitting around the insulator, a burner within the globe, and a device *h*, connecting the burner with the interior of the vessel, as set forth.

2. In an electric lamp, the combination of a vessel *g*, insulator supporting the vessel, a globe having an opening at bottom to fit over the insulator and an opening at top to permit the atmospheric air to escape, valve closing said top opening, a burner within the globe, and a device *h*, connecting the interior of the vessel with the burner, as set forth.

3. In an electric lamp, the combination of a vessel *g*, insulator supporting the vessel, a globe having an opening at top, valve *i* closing said top, screw *i'* for adjusting the valve, a burner within the globe, and a device *h*, connecting the interior of the vessel with the burner, as set forth.

4. In an electric lamp, the combination of a vessel, *g*, for containing hydrocarbon, and adjustable in its support, a burner having an adjustable portion, and a device *h*, resting on the bottom of the vessel, connected to the adjusting portion of the burner to support the latter, and adjustable with the vessel, as set forth.

5. In an electric lamp, the combination of vessel *g*, burner, and device *h*, having a wick *h'*, dipping into the vessel, as set forth.

10. In an electric lamp, the means for connecting the vessel *g* to the insulator, consisting of externally-screw-threaded tube *g'* and internally-screw-threaded tube *g''*, as set forth.

11. In an electric lamp, the combination, with suitable connecting-wires, of the insulator *b*, carrying wires *c c'*, contact-ring *e*, and spring contact piece *e'*, and the insulating-support *f*, having contact-ring e^2, spring contact-piece e^3, and wires c^2 c^3, as set forth.

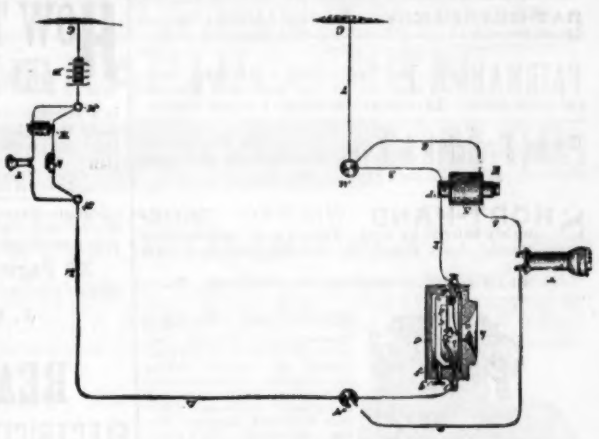
Telephone circuit; Wm. H. Eckert and John A. Seely, New York, N. Y 282,867

The object of this invention is to dispense with local batteries at subscribers' stations, though still employing the ordinary contact-transmitter in the primary circuit of an inductorium.

The battery necessary to effect transmission is located normally in the main line at the central stations, and at the subscriber's station the main line is divided into two multiple-arc branches, in one of which is placed the transmitter and primary coil of the inductorium, and in the second branch the secondary coil of said inductorium, and, in addition, if desired, a receiving telephone.

The main line may be divided into two branches at any point along its length, and a telephonic transmitter also inserted in the branches of the circuit, or the same may be done at the central station near the battery. The transmitter and primary coil are included in one branch and the secondary coil and the receiver in the other branch.

Variations of current strength in the primaay coil cause corresponding impulses to be set up in the secondary of the induc-



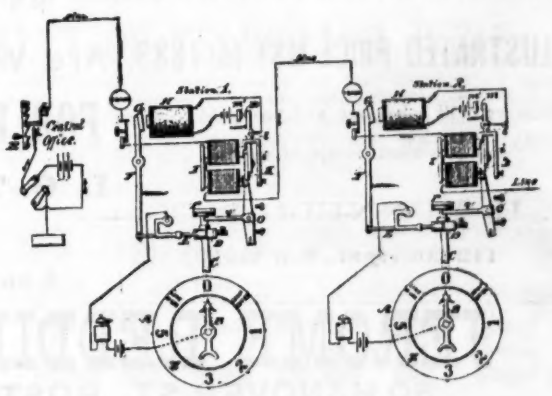
torium, and these impulses, though partially short-circuited in branch 1 2 3, pass over line *L* to a distant station in sufficient strength to effect the reproduction of speech in a practical manner. The tension of current from battery *B* being very low compared with that of the induced current, electrical pulsations set up in coil *s* alternately augment and suppress the battery-current, and thereby produce vibratory or undulatory currents practically of the same character as though no battery were on line.

Claim. 1. The combination of a main line provided with battery, two main-line branches unprovided with battery, in one of which is placed a telephonic transmitter and one coil of an inductorium and in the other the secondary coil of the inductorium.

2. The combination of an inductorium whose primary and secondary coils form parts respectively of two main-line branches, said branches being unprovided with battery, a telephonic transmitter placed in one of said branches, and a main line and battery.

3. The combination of a main line provided with battery, two main-line branches unprovided with battery, in which are placed respectively a telephonic receiver and transmitter and an inductorium whose coils form parts of said branches, as described.

Unison mechanism for electrical indicators; Frank H. Snell, Washington, D. C 282,591



The device is intended for the purpose of bringing to unison or coincidence the pointers of every one of a number step-by-step electro-magnetic instruments or indicators worked serially in one circuit, when from any cause the indications become deranged at any of the instruments by failure to work properly. The electro-magnet *I* in the main circuit contracts an armature *l* that works the contact points *m' m* of a local circuit, including a magnet *H*. This magnet works a lever *F* to which is attached a pawl *E* that works the ratchet wheel *D*, which causes the index hand to move. Every impulse of current in the main causes the motion of the pawl over one tooth of the ratchet wheel. The electro-magnet *I* also works a polarized armature *n s*, pivoted at *O* which has an extension *q*.

As long as the current remains in the same direction in the main circuit the polarized armature is attracted to the pole of the electro-magnet *I*, but on reversing the current it becomes repelled by this pole and attracted by the extension *i* of the other pole. In this condition the extension *q* moves in the way of the arm-piece *P* carried by the shaft of the ratchet wheel. It is evident, therefore, that on sending impulses of current in the main line, from a central station for instance, the step-by-step motion of each indicator will proceed until the arm *P* comes against the extension *q* and stop, in which case the indicators will all be in coincidence. On reversing the current in the main line the polarized armature will assume its former position and the extension *q* will move out of the way of the arm *P*, so that the synchronous movement of the indicator is then possible.

BUSINESS NOTICES.

NEW FOOT LATHE FOR ELECTRICIANS.—We commend the reader to an invitation made by the Narragansett Machine Company, of Providence, R. I., which enables everybody to acquaint himself with the structure and capabilities of the Providence Lathe, so far as this can be done by means of the catalogue which the company sends on application. It would be superfluous to add, that electrical experimenters and brass-workers in general who make themselves owners of the machine itself, have an aid to their ingenuity which it is not less pleasant than useful to have in operation, because it works with unfailing accuracy.

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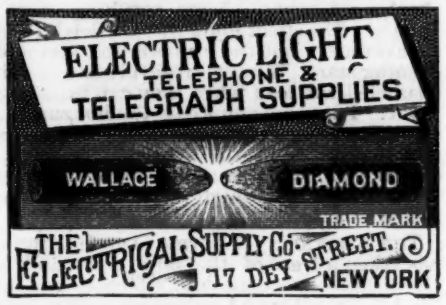

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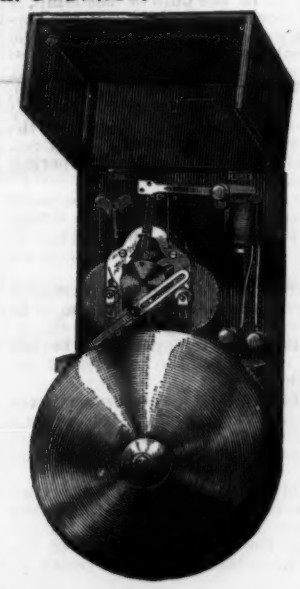
Proprietor Bay State House, Worcester, Mass.
July 11, 1883.



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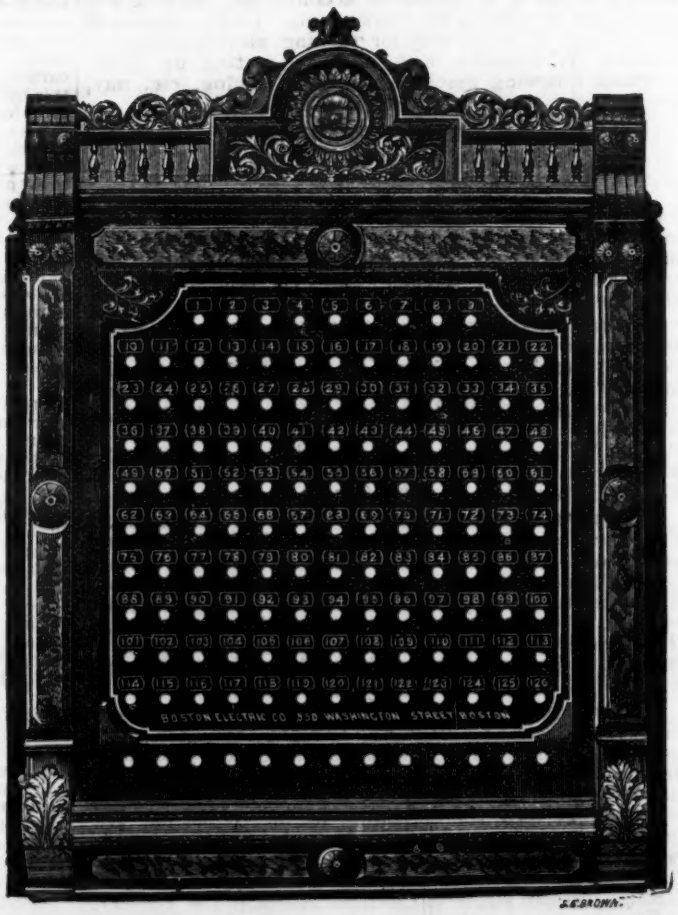

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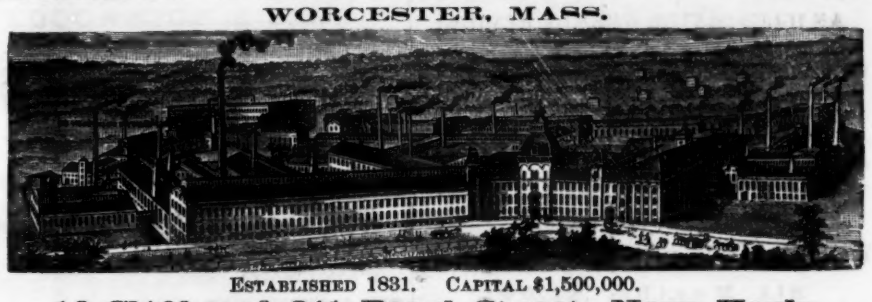

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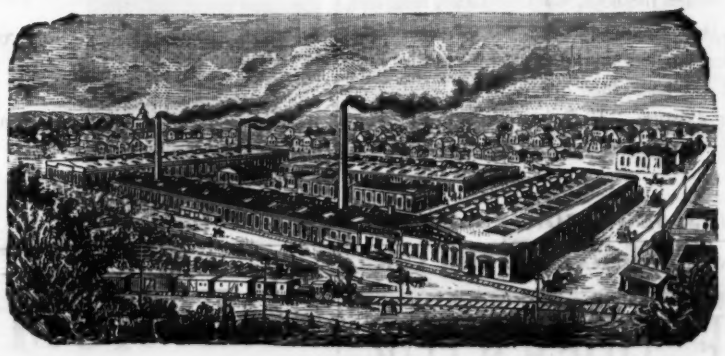

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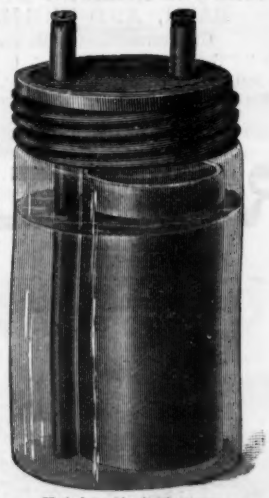

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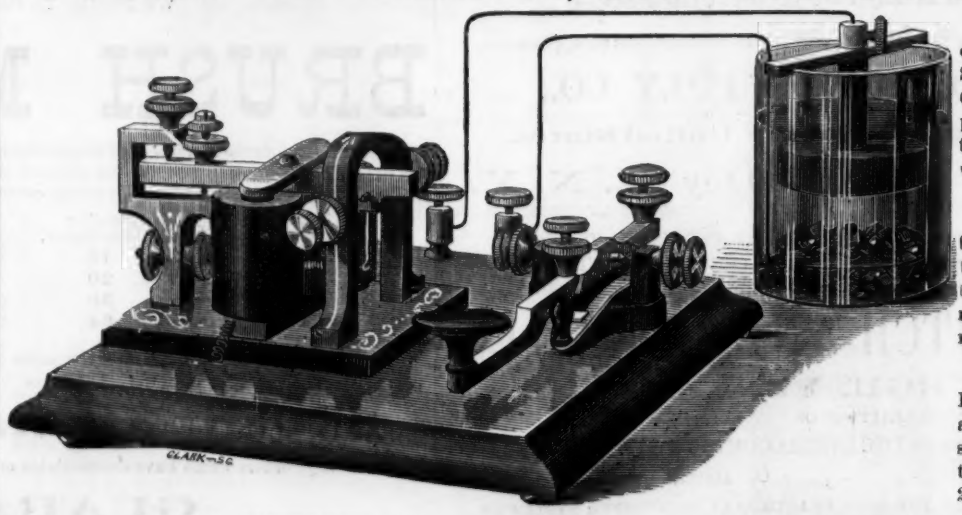

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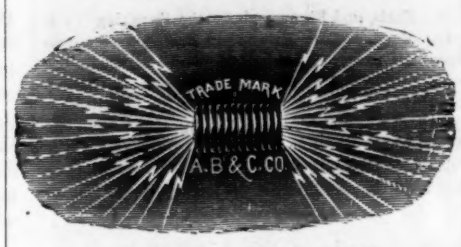

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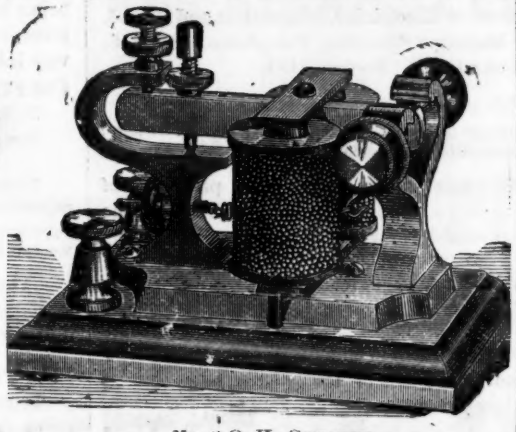

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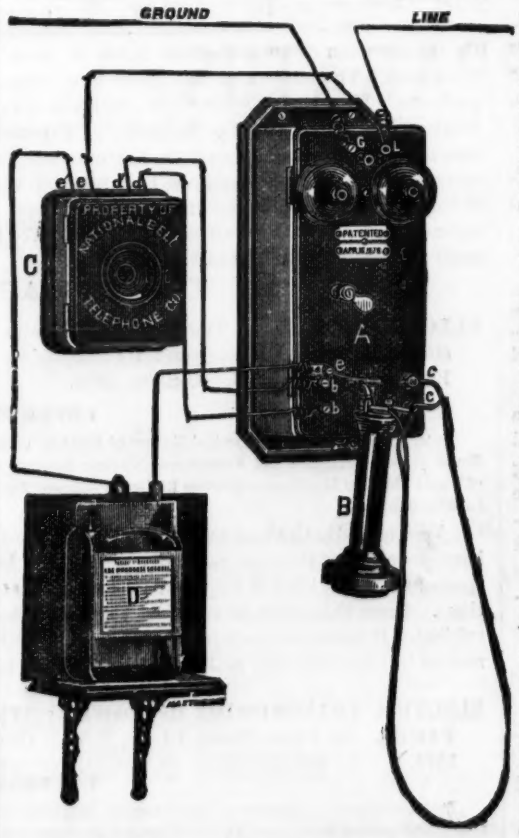

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The chapters of which this book is composed were originally published in The Operator, where they were found so useful to practical telephone men as to induce an imperative demand for their re-publication in the present convenient form. The book, while giving a mass of valuable information, such as could only be acquired by an extended practical experience with the telephone, is written in an easy, chatty style, which makes it entertaining reading. It is the only book that contains a description of the Blake transmitter, now used almost universally throughout the United States. No one who has anything to do with telephones can fail to find in it something of interest or value; but it is particularly useful to the managers and employés of telephone exchanges, as it gives them valuable instruction about every detail of their work.

THE TELEPHONE. An Account of the Phenomena of Electricity, Magnetism and Sound, as Involved in its Action; with Directions for Making a Speaking Telephone. By A. E. Dolbear. Second Edition. 18mo, cloth, 17 illustrations. Boston, 1883. 50c.

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Electricity—Magnets—The Galvanic Battery—Other Means for Generating Electricity—What is Electricity?—Sound—Correlation—Reiss, Gray, Bell and Dolbear Telephones—How to Make a Telephone.

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THE SPEAKING TELEPHONE, ELECTRIC LIGHT, AND OTHER RECENT ELECTRICAL INVENTIONS. By George B. Prescott. 8vo, cloth, 319 illustrations and 1 plate. New York, 1879. $4.00.

CONTENTS.

The Speaking Telephone—Bell's Telephonic Researches—The Telephone Abroad—History of the Production of Galvanic Music—Gray's Telephonic Researches—Edison's Telephonic Researches—Electro-Harmonic Telegraphy—Dolbear's Telephonic Researches—Improvements of Channing, Blake and others—The Talking Phonograph—Quadruplex Telegraphy—Electric Call Bells—The Electric Light—Edison's Recent Telephonic and Acoustic Inventions—Duplex Telegraphs, Electro-Magnets and Electric Time Service.

This is a large and handsome work, the object of which is to furnish the public with a clear and accurate description of the more recent and useful improvements in electrical science, and especially to explain the principles of that marvelous production, the speaking telephone. The most interesting portion of the work, to most readers, is the history of the original telephonic researches of Bell, Gray and Edison, the account of each inventor's experiments being given in his own words. It contains also a very thorough description and explanation of the quadruplex telegraph, with numerous diagrams, showing how the wires are arranged, and gives excellent accounts of the Brush, Maxim, Jablochkoff, Thomson-Houston, and other systems of electric arc lighting, with descriptions of the dynamos, etc. The illustrations throughout the work are very fine.

ELECTRIC LIGHTING.

ELECTRIC LIGHT, ITS PRODUCTION AND ITS USE; EMBODYING PLAIN DIRECTIONS FOR THE WORKING OF GALVANIC BATTERIES, ELECTRIC LAMPS AND DYNAMO-ELECTRIC MACHINES. By J. W. Urquhart, C.E. Edited by F. C. Webb, M.I.C.E., etc. 8vo, cloth, 94 illustrations. London, 1880. $3.00.

CONTENTS.

Introduction—Voltaic Batteries—Thermo-Electric Batteries—Magneto-Electric Generators—Electro-Magnetic Electric Machines—Dynamo-Electric Machines—General Observations on Machines—Electric Lamps and Candles—Measurement of Electric Light—Mathematical and Experimental Treatment of the Subject—Application and Cost of the Electric Light.

A very convenient and complete treatise on the electric light. The principles are defined in a manner devoid of technicalities, so as to render the book very valuable to the beginner. The history of the dynamo-electric machine and its development, from the Pixii to the Gramme machine, is also quite complete. The recent types of machine receive a full share of attention and the various styles of lamps are treated in full.

ELECTRIC LIGHTING. Translated from the French of Le Comte Th. du Moncel, by Robert Routledge, B.Sc. Crown 8vo, cloth, 76 illustrations. London, 1882. $1.25.

CONTENTS.

General Considerations—Generators of Electric Light—Electric Lamps—Cost of Electric Lighting—Applications of Electric Light—Conclusion—Notes and Appendices.

A translation of the work of this prolific writer on electrical subjects, published at Paris, in 1880, under the title of "L'Eclairage Electrique," to which the translator has added brief accounts of the apparatus connected with electric lighting which have been brought forth since the publication of the original edition, viz., Swan's, Maxim's, Edison's, and Fox-Lane's incandescent lamps, and the Faure secondary battery. To the student or the general reader who desires information free from abstruse technicalities, and at an insignificant cost, on a subject that is attracting general attention, this work, the original of which is one of a popular science series, can be recommended. The object held constantly in view by the author was to make the treatise thoroughly practical. The book is the cheapest one that aims to cover the whole ground of electric lighting.

ELECTRIC LIGHTING AND ITS PRACTICAL APPLICATION; WITH RESULTS FROM EXISTING EXAMPLES. By J. N. Shoolbred. 8vo, cloth, 5 plates. London, 1879. $2.00.

CONTENTS.

Historical and Descriptive—Electric Light Machines—Lamps and Regulators—Carbons; Conducting Wires—Motive Power—Luminous Intensity—Applications; Economic Results—Prospects of Electric Lighting.

A handy little treatise, very valuable to the beginner. The author adopts a popular method of treating the subject and avoids technicalities as much as is compatible with the precision of the work. The history of the early efforts in this field is given, the apparatus being briefly described in each case. The notice of recent inventions, up to the date of print, is quite complete. The questions of power and of photometry form the subjects of very interesting and instructive details.

USEFUL INFORMATION ON ELECTRIC LIGHTING. By Killingworth Hedges, M.S.T.E. Fourth Edition, Revised and Enlarged. Crown 8vo, cloth, 20 plates. London, 1883. $1.75.

CONTENTS.

Production of Electricity—Voltaic Arc—Division of the Electric Light—Machines or Generators—Power required, and Motors—Application of the Electric Light—Choice of a System—Setting to Work—Cost of Working—Measurement of Light and Current—Storage of Electricity and Transmission of Power—Electrical Measurement of Work—Useful Memoranda.

The first edition of this work met with so great a success as to encourage the issue of enlarged second and third editions, which have in turn been exhausted. A fourth edition, still further enlarged, has just been issued.

ELECTRIC LIGHTING BY INCANDESCENCE, AND ITS APPLICATION TO INTERIOR ILLUMINATION. A Practical Treatise. By William E. Sawyer. 8vo, cloth, 96 illustrations. New York, 1881. $2.50.

CONTENTS.

Introduction—Generators of Electricity—Generators of the Gramme Type—Generators of the new Siemens Type—Incandescent Lamps—Carbons for Incandescent Lighting—New Forms of Lamps—Preservation of Incandescent Carbons—Division of Current and Light—Regulators and Switches—General Distribution—Commercial Aspects.

This book is an indispensable addition to the libraries of all who desire to keep up to the age in the novelty of electric lighting. Its author neglects the arc light altogether, and gives his readers a graphic account of the generators employed in the production of the necessary currents; of those lamps which utilize the currents when generated; of the most advantageous circuit arrangements and apparatus, and of the best materials to use in lighting by incandescence. A historical sketch shows that the idea of electric lighting by incandescence is as old almost as telegraphy itself. The book is handsomely printed and copiously illustrated.

INCANDESCENT ELECTRIC LIGHTS, WITH PARTICULAR REFERENCE TO THE EDISON LAMPS AT THE PARIS EXHIBITION. To which is added The Economy of the Electric Light by Incandescence, by John W. Howell; and On the Steadiness of the Electric Current, by C. W. Siemens. Illustrated. 18mo, boards. New York, 1882. 50c.

There is no book that contains more valuable information in the same space than this. On the question of incandescent lights it must be considered the best authority at present accessible. The tables and data given help very much in analyzing facts and making comparisons. The article by Mr. C. W. Siemens is especially valuable and interesting. It refers to a new method of exciting the field of dynamo-electric machines, which enables the current to maintain itself constant in the external circuit, no matter how great and rapid the variations of resistance may be. This method has come into use as a most valuable adjunct in the dynamos intended for incandescent lamps, where it enables any of the lamps to be put on and off at will without affecting the rest. For this reason this article is of great interest to every person interested in electric lighting.

VARIOUS APPLICATIONS.

ELECTRO-MOTORS. A Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy and its conversion into Motive Power. By J. W. Urquhart. 12mo, cloth, illustrated. London, 1882. $3.00.

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ELECTRIC TRANSMISSION OF POWER; ITS PRESENT POSITION AND ADVANTAGES. By Paget Higgs, LL.D., D.Sc. Crown 8vo, cloth, 21 illustrations. London, 1879. $1.20

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Dynamo-Electric Machines—The Gramme Machine—The Brush Machine—The Wallace-Farmer and Siemens' Machines—Efficiency of Dynamo-Electric Machines—Practicability of Transmission of Power by Electricity—Efficiency of Coupled Machines—Comparative Efficiency of Various Machines—Other Theoretical Considerations—Conclusions.

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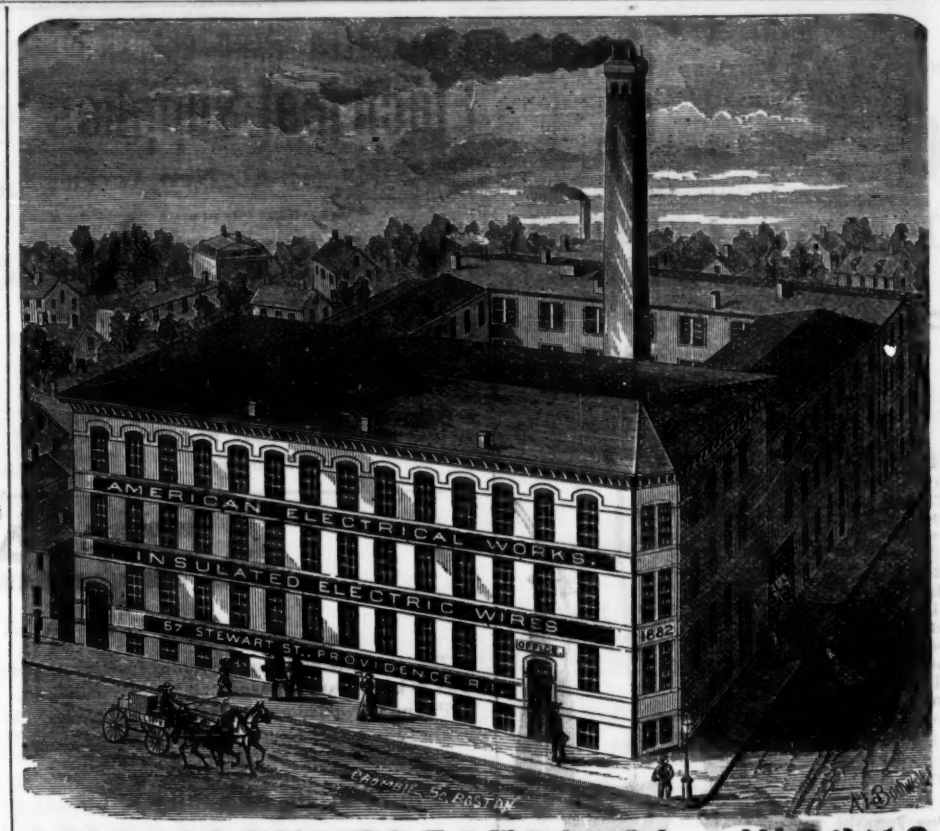

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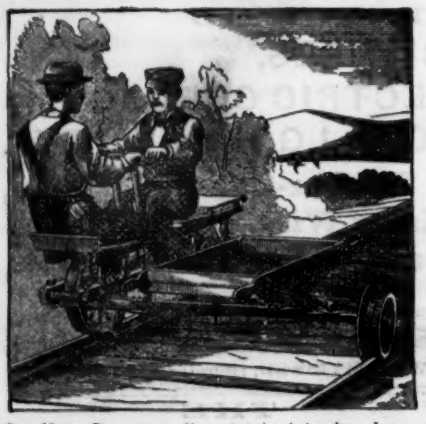

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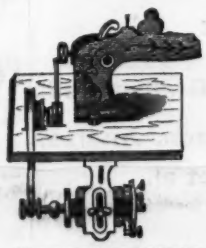

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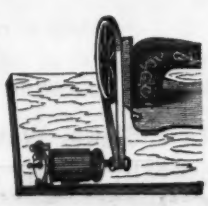

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